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VOLUME XX JANUARY 5, 1931 NUMBER

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Devoted to the practical application of dyestuffs in all industries; especially to textile chemistry—the science and practice of scouring, bleaching, dyeing and finishing.

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The Value of Theory in Solving Chemical Problems

By H. W. Eastman

FUNDAMENTALLY, chemistry is no different than any other profession, and there comes a time when chemistry having carried one as far as possible in arriving at the real reason why certain very apparent conditions exist must be laid aside and a theory evolved to account for conditions which a chemical examination has rendered apparent. Without a theory to work upon, the correct diagnosis, at times, is all but impossible, but with a definite theory, even though it may eventually need revision, or prove to be wholly wrong, the basis for further investigation is laid.

The events leading up to the story upon which this article is based actually happened and will serve to illustrate the several steps taken in arriving at the correct solution of the trouble; i.e., analytical; an explanation of the difficulty; its correction; and how further complaints of a similar character were prevented.

Fast Dyes Cause Staining?

Embroidery threads dyed in colors guaranteed to be fast to boiling soap solution and to cause no staining in white material had found a market in the export trade, and were being used for embroidering doilies, napkins, table covers, etc. The finished articles were already being received back in New York City for distribution in this country and throughout the world. A very definite market seemed assured, the designs were hand-embroidered and beautifully executed, while the material carrying the embroidery was finely woven cottons and linens.

Suddenly, when everything seemed to be moving along smoothly, complaints began to be received that the colored embroidery thread was staining the white material. These complaints shortly reached the mill, and soon were in the laboratory for examination.

Complaint Apparently Justified

While several different shades had been used in the work, the colors which seemed to predominate were deep blue, crimson, black and light pink. An examination of the returned articles immediately disclosed that the complaints were apparently fully justified, but the indications were that only the black and crimson colors were causing the trouble, the blue and the pink being fully up to the required standard. That trouble existed, and plenty of it, was clearly evident from the returned exhibits. Sections of both the black and the crimson colored thread had bled badly onto the white material, but what immediately impressed the writer as particularly interesting was the fact that all of the black, and all of the crimson thread did not show evidence of bleeding into the white ground. Certain of the embroidered articles showed only comparatively small stained sections of black and crimson, while in others, nearly, or quite all, were badly stained. The stains had the appearance of being loosely held on the fabric, and seemed to be spread on the surface. They did not resemble ordinary dye stains where the natural gloss and translucency of the fibers remains, but in the case under consideration, showed a definite opaqueness apparent in the fibers, while the thread and the fabric itself where the stains had occurred assumed a pronounced stiffness.

The exhibit was brought to the attention of the head dyer who expressed the opinion that his assistant had in some manner improperly dyed the material which had been sent out to the trade. The longer the writer studied the situation the more convinced he became that the dyer, no matter how "worried or hurried," would never have so mistreated any material which he was expected to dye.

Laboratory Experiments Disclose Character of Stains

Preliminary experiments conducted in the laboratory consisted in merely dipping the fabric in cold water, in a beaker, and it was at once observed that streaks of black and crimson color immediately spread through the water showing that the dye was only very loosely held. In the meantime a bath of sodium hydrosulphite at 160° F. had been prepared, and as soon as the material was dipped in this bath all of the black and crimson stains disappeared from the white portion of the material, while the black and the crimson thread, which had

caused the trouble assumed a deep blue and a light pink color respectively. The articles were dried, and again examined, when it was found that the stains had been permanently removed and that the pink and blue embroidery threads were a perfect match for colors which were standard articles in the regular line. At the same time, chemical tests showed that the dyeings were identical with those in the original line. A still closer examination, including determination of length of staple, twist, and size of thread, showed, without a question of doubt, that the thread was our own product.

It was further noted in the napkins from which the stains had been removed, that certain designs in which the black predominated, would change abruptly to a deep blue, which would continue for perhaps one or more needlefuls of thread, and would again change into a deep black. The same condition prevailed in the crimson which was found interspersed, here and there, with one or more needlefuls of light pink.

All the returned articles were given a hydrosulphite treatment, and the same condition, as previously noted, was found to exist in each case.

Need of Theory Apparent

What could have caused the stains, and how could such embroidery cotton find its way into a line of guaranteed fast colors? Could it be that the dyer had had trouble with a deep blue and pink and redyed them black and crimson? It seemed logical that the answer must be emphatically "No," for the very simple reason that no dyer capable of handling such material would have ever considered the use of the extremely fugitive colors which had been employed, and the idea, that the goods were fill-redyes, was dismissed.

Theory is Evolved

How then had extremely fugitive colors been used as topping for fast colors? Bearing in mind that these embroidery cottons were handled in the export trade, certain questions presented themselves for answer, and the following theory was evolved. (1). Was the embroidery work done in towns or cities, which would incidentally mean that the work was most probably done in factories, each under single heads? (2). Was the work done in small communities or country districts where each worker would be guided by his own judgment and environment? No logical answer suggested itself if the conditions were as imposed by the first question, but, if the conditions outlined by the second question were existent, it was felt that a working theory could be devised, which, if later found to be impracticable was at least worthy of consideration.

If the work was done by needle-women throughout the surrounding country districts, it seemed logical to let the imagination run riot for a short time, and the following theory was concocted. Perhaps ten, fifteen, or twenty miles away from the person or concern who originally supplied the work, in a remote, inaccessible country section was a family one or more members of which were expert in needle work. After the long difficult trip to town, the articles to be embroidered had been obtained, together with supposedly enough thread with which to complete the work. In the course of time it was found that insufficient black and crimson thread had been obtained, although there was blue and pink in excess of what would be required for the work in hand. The worker, thereupon, conceived the brilliant idea of redyeing the blue to a black and the pink to a crimson shade. Not realizing that any fastness requirements existed, the worker was only interested in obtaining the shades of black and crimson, and if the foregoing conditions were existent, it must be taken for granted that the shades obtained were fairly good matches, inasmuch as they must finally have passed some form of inspection before the worker would have been paid for her work. Everything was apparently satisfactory until the material was wet with water, when the damage occurred. Judging by the appearance of the fabrics when first viewed by the laboratory, one would assume that the black and red colors used in the staining had come directly from bottles of black and red ink.

Management Skeptical of Theory

The above theory was submitted to the management, who were quite frank in admitting that there seemed to be "Considerable Theory," and with this opinion the writer was quite willing to agree although it seemed as feasible as any which could be devised.

It fortunately happened that the foreign representative was in this country at the time and arrangements were made for the writer to meet him and discuss the situation. He seemed anxious to arrive at the correct solution of the mystery, and immediately admitted that the work was not done in a central factory, but was actually done by needle-women scattered throughout the outlying country districts, the work being obtained and returned by them on their none too frequent trips to the town. He was about to return to his native province, and promised to make a thorough investigation as soon as he arrived home.

Within a short time word was received which definitely proved that the theory propounded by the chemist was essentially correct in every detail.

Thus the responsibility for the trouble was placed directly where it belonged, the fastness guarantee was upheld, and the way cleared for a resumption of the cordial relations which had existed prior to the time when the stains first began to appear.

Without some definite theory to build upon, the work of the chemist would have stopped far short of the solution of the trouble, and while an adjustment would have undoubtedly been made covering the value of the ruined articles, the prestige of the company would have suffered unjustly, irreparable harm over a condition for which they were in no way to blame.

Proceedings of the American Association of Textile Chemists and Colorists

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NOVEMBER MEETING OF THE MIDWEST SECTION

THE last quarterly meeting of the Midwest Section of the American Association of Textile Chemists & Colorists for 1930 was held on Saturday evening, November 15th, 1930, at the Bismarck Hotel, Chicago, Illinois.

The meeting was preceded, as usual, by an informal dinner with seventy-seven members and guests present.

The meeting was called to order by the chairman, Mr. Carl Bick, who expressed his thanks for the interest shown by the members in their attendance at the meetings since the organization of the section and for the cooperation of his fellow officers. Attention was then called to the fact that the father of Mr. Arthur Brainerd had just passed away, and a motion was duly made, seconded and passed that those present should stand with bowed heads a moment and also that the secretary write a letter of condolence to Mr. Brainerd. (All stood a moment with bowed heads.)

Due to a business appointment elsewhere, Mr. Bick then turned the meeting over to the vice-chairman, Mr. M. A. R. Selisch, who presented Mr. Bick with a handsome onyx fountain pen desk set and letter from the Real Silk Hosiery Mills expressing their appreciation of the fact that he had served as chairman of the Midwest Section of the A.A.T.C.C. for two years and in having thus been recognized, had reflected honor on them.

Minutes of the previous meeting were read and approved as read, followed by the treasurer's report.

The Nominating Committee, consisting of B. G. Blowney, Chairman, C. Willie, E. F. Thompson, and E. A. Hoeft, nominated the following, who were elected to serve for the coming year: E. W. Morgan, Chairman; M. A. R. Selisch, Vice-Chairman; Wm. Bergh, Jr., Secretary; S. A. Beery, Treasurer; A. T. Brainerd, member of the National Nominating Committee.

The question of having the National Convention meet in Chicago during the World Fair in 1933, was then taken up and it was decided to announce at the National Convention being held in Chattanooga, Tenn., this year, the fact that in 1932 the Midwest Section would put in a formal request to hold the 1933 National Convention in Chicago during the World Fair.

Mr. H. G. Smolens, Consulting Engineer of the Buffalo

Electrochemical Co., Inc., then gave an interesting talk entitled "Some Notes on Peroxide Bleaching", which was followed by a general discussion.

A rising vote of thanks was extended to the speaker of the evening and the meeting thereupon adjourned.

Respectfully submitted,

WM. BERGH, JR.,
Secretary.

Some Notes on Peroxide Bleaching

By H. G. SMOLENS

Consulting Engineer, Buffalo Electrochemical Co., Inc., Buffalo, N. Y.

PEROXIDE Bleaching may be divided into three eras, the first, ending about 1912, in which barium peroxide and the hydrogen peroxide solutions made from it, were used almost exclusively; the second, ending about 1927, in which sodium peroxide and the hydrogen peroxide solution made from it were mostly used; and the third, the one which we are interested in, which is bringing into exclusive use the concentrated peroxide of hydrogen solutions made from potassium persulphate or from persulphuric acid, on a scale and in a manner undreamed of even five years ago.

This discussion pertains mostly to the present and the immediate future of peroxide bleaching and only to the concentrated peroxide of hydrogen solutions that we are now and will be using, as they are the only peroxides stable enough and reliable enough to allow fairly accurate duplication of good results. The other peroxides are either already out or are quickly passing out of the textile chemical field both in the United States and in Europe.

Before saying any more of these concentrated peroxide solutions or of bleaching with them, it is probably advisable to admit without hesitation, that we do not know exactly what these hydrogen peroxides really are, nor do we know very exactly what the reactions, which result in what we call bleaching, are. Under these conditions it is really quite remarkable that we are able to make these peroxides as well as we do and it often appears almost miraculous that they produce the bleaches which our customers are daily turning out.

Peroxide bleaching involves the removal from fibers, without injury to these fibers, of the natural coloring matters which are inherent to them. We do not know just what these coloring matters are. We assume that they are oxidized by means of the peroxide bleaching reaction, into chemical compounds which are soluble in water and can, therefore, be removed from the fiber by washing with water.

It is rather fortunate for bleachers and, incidentally, for manufacturers of peroxides, that it is possible to make up and apply peroxide bleaching solutions which will bleach without appreciable injury to, the fibers that are well bleached. This possibility was, until only a few years ago, a very haphazard proposition, and the art of peroxide bleaching was a matter of secrecy, shared by a few bleachers with the manufacturers of peroxides. There was little or no science applied to these mysterious processes, with the result that peroxide bleaching was a necessary evil in many bleacheries, subject to laws of chance and acts of Providence.

Within the past five years, it has been discovered, almost accidentally, that it is possible to make chemical and electro-chemical tests on peroxide bleaching solutions and that, by recording the test figures which produced the best results, it is fairly easy to duplicate these figures and ultimately to duplicate these results. This recording of test figures is erroneously called "control." There is no such thing as controlling a peroxide bleach. Once you have made up the peroxide bleaching solution and applied it to the material to be bleached, the only control usually possible is a control of one's temper.

The test figures mentioned above, properly interpreted, however, allow us, upon comparison of fibers that have been peroxide bleached, either with standards or with other figures and bleaches, to so change our records or formulae as to produce or get closer to some desired result.

Such interpretations are as accurate as the interpreter's knowledge of the peroxide bleaching chemicals, their effective combinations and their anticipated actions under a given set of conditions. This is why it is rather difficult for even trained chemists, who have had no extensive practical experience, to work out reasonably accurate peroxide bleaching processes in the laboratory or on an experimental scale. For example it is one matter to immerse a piece of boiled off silk and cotton crepe in a beaker containing a peroxide bleaching solution, heating it to a high enough temperature and getting a fine bleach in an hour or less; but an entirely different matter to get a satisfactory bleach on the same crepe, boiled off in bags in a laundry machine and immersed in a bleach tub built of cement, which has a positive catalytic action on the peroxide bleaching solution as soon as the temperature is around 130° F. so that the peroxide strength is practically lost before the bleaching actually begins. Similarly, it is fairly easy to do excellent bleaching of cotton piece goods in a clean, well lined experimental pump and heater kier holding a ton or so of cloth, when you have all the finest and

most modern auxiliary equipment, a good supply of soft clean water, skilled help of all kinds, a chemical laboratory, etc.; but it is not so easy to turn out first class peroxide bleached goods in an old three ton, center vomit, off size kier, operating on low pressure steam, in a bleachery that was old in 1910.

The point of all this is that, even when you have a formula which produces a desirable result under conditions that have little or no effect at all upon the chemicals in the formula or on the material to be bleached, it will very seldom work out properly on a practical scale where almost everything that touches the solution or the goods has a detrimental effect of some kind on them. The cleaner and more modern the existing bleachery equipment, the better the peroxide bleaching that can be done in it. This is the main reason why the best and most economical peroxide bleaching of cotton piece goods is being done in the south, at the present time.

The ideal of all peroxide bleachers and the ultimate of all peroxide bleaching is to receive the grey goods, whatever they may be, give them one treatment with a peroxide bleaching solution, and have them ready for finishing. This is already possible and practicable on some classes of work. For example, silk and cotton hosiery, some cotton yarns, cotton knit goods, some rayon and cotton fabrics, are being handled in this ideal bleaching manner.

The great bulk of peroxide bleaching, however, is still being done in at least two stages, first a scouring or boil off, and then, the actual bleaching. The main reasons for this are that the natural or artificial impurities which are present on the grey goods that the bleacher receives, are either acted upon and fixed on the fiber by the peroxide bleaching chemicals or that these impurities are removed more cheaply by chemicals that are less expensive than the peroxides.

There are so many elements connected with peroxide bleaching which are dependent on purely local conditions, that it is nearly impossible to classify it into standardized processes.

Practise

Wool stock is always scoured well before being peroxide bleached. As far as possible, we prefer not to bleach wool stock, because the value of the bleach, that is, color and condition, is more or less lost in the carding, spinning, weaving and finishing that the wool must undergo in its preparation for marketing. Wool yarns are practically always scoured before bleaching. The best color and condition of these yarns is obtained by hand scouring, then immersion in a sationary peroxide bleaching solution for from six to fifteen hours, then exposure to sulphur dioxide gas obtained from burning sulphur. Wool piece goods are usually fulled, after scouring, then washed, peroxide bleached by being run on an overhead revolving reel through a bleaching solution in a tub, and finally soured for a cream white, given a bisulphite finish for a snow white or tinted for a blue white. Wool knit goods are fulled, before washing or scouring, then peroxide bleached in a machine similar to that used for piece goods, and finally soured for cream white.

Silk is brought to the bleacher mostly in the form of piece goods. Ordinary grades of white silks are first boiled off, then peroxide bleached in a variety of ways, as, for example, on jigs, by immersion in stationary liquors in tubs, by padding and shelling and, in continuous machines. Tussah silks are handled somewhat differently, but information regarding their best bleaching is known only to a few bleachers and is very jealously guarded. Silk and wool fabrics must be handled so as not to injure the wool, the more delicate of the two fibers. Silk and cotton or silk and rayon fabrics are bleached in an almost infinite number of ways, depending on the results desired and on the local operating conditions.

Cotton raw stock is lightly peroxide bleached, usually in pressure machines, mainly as a preparation for dyeing with vat colors. This dyed stock is then spun into yarns for use in fabrics such as towellings, shirtings, etc. which are ultimately to be peroxide bleached as part of their finishing processes. Cotton yarns are peroxide bleached in skeins, in warps or in packages. This work is done in kiers of various kinds, in the different skein dyeing machines, in laundry washers and in the several beam or package dyeing machines. Yarns such as peelers are usually given a simultaneous boil and bleach, as this produces the softest, loftiest and strongest yarn with the smallest loss in weight. Sak and Egyptian yarns are, as a rule, given two or more peroxide bleaches for the best results in color and strength. The best flat lock threads produced in this country are peroxide bleached. Cotton knit goods, for peroxide bleaching, are handled in a manner similar to yarns, but mainly in kiers or in string reel machines. The only difference in the processing is due to the small amount of knitting machine oil which the goods always contain and which make them a little more difficult to wet out. Cotton piece goods are being most successfully peroxide bleached today in many bleacheries. The actual process depends somewhat on the construction of the cloth and on the finish desired. The least expensive way of peroxide bleaching cotton goods allows the cloth to be prepared in exactly the same manner as for a chemic bleach. Then, instead of pulling it out of the kier, the peroxide bleaching charge

is introduced and the cloth is given a peroxide boil. Such cloth usually has a better and more permanent color and a superior bottom to cloth bleached with chemic. The cost of the peroxide bleaching chemicals for this purpose is now about $0.16 per lb. of cloth bleached. This means about 0.03c per yard of a 64 x 60, 5.35 print cloth which, allowing for the difference in labor, power, space and production, is not more than the average cost of chlorine bleaching.

Future

The extraordinary development of the technique of peroxide bleaching and of the methods of utilizing the available bleaching chemicals, has advanced much more rapidly than improvements to equipment or the introduction of new machinery for peroxide bleaching. Recently, however, there has been more of an effort on the part of textile finishing machinery manufacturers to bring out new ideas or machinery for this kind of processing, usually bearing in mind that textile finishers are not too keen for machinery replacements at the present time.

There is now being offered to cotton bleachers a new system of kier circulation in which the kier liquor is drawn from the top of the kier and pumped into the well, from which it is made to rise through the contents of the kier. A closed heating coil under the grate takes further advantage of the natural flow of heat. This kier circulating system apparently removes all troubles due to channeling, conserves heat, therefore steam, and seems to be a considerable improvement over the usual downward circulating systems.

Within a short time, also, there will be put into operation an entirely new type of continuous bleaching machine for cotton fabrics, in which the cloth, after a proper preparation, will be moved at speeds of from sixty yards per minute to over one hundred yards per minute, first through a caustic boiling solution and then through a peroxide bleaching solution. When the cloth leaves this machine it will be ready for dyeing and finishing. This machine will not only afford production economies due to continuity of operation, but will also produce a superior color and bottoming on cotton goods at probably a most reasonable cost.

Several attempts, apparently unsuccessful to date, have been made to bleach wool stock in the standard wool scouring machine, as part of the scouring operation. This will possibly be worked out to some fair degree of success during the next year.

Very soon, we hope, it will be an ordinary procedure to continuously scour and bleach woolen piece goods, even piece goods which have colored borders, designs or stripes. A process has recently been developed by one of the prominent dyers to dye wool yarns fast to peroxide bleaching. This will allow blanket manufacturers especially, to bleach their products with peroxides, instead of giving them the rather unsatisfactory sulphur bleach.

Silk and silk mixed goods will also soon be peroxide bleached in continuous machinery. As the demand for lower priced silk goods brings more and more tussahs and off color silks into the market, new methods of peroxide bleaching these silks will be devised. The agitation that may ultimately result in the stoppage of weighting silk piece goods, will probably also make greater demands on peroxide bleaching for silk goods.

In the cotton goods finishing trades, the introduction of new finishing machinery based on peroxide bleached goods, the building of new bleacheries entirely for peroxide bleaching, improvements in the existing equipments and methods of making them more more inert to the peroxide bleaching chemicals, and, finally an awakening of the cotton bleachers to the actual possibilities of the peroxide bleaching of piece goods, will certainly result in the gradual elimination of all the older forms of bleaching.

The next new opportunity for peroxide bleaching will be in rayon yarns, which are now bleached almost entirely with soda chemic. This is a matter of equipment, not of technique. The manufacturers of rayon yarns are already beginning to manifest an interest in peroxides and in peroxide bleaching which was entirely lacking until very recently.

TENTH ANNUAL MEETING

Technical Session Followed by Award of Prizes Professor Olney Elected President Emeritus

President Wood: I am going to call on Dr. Harold to make a report on the prizes awarded annually by the Association for the best papers presented during the year. Dr. Harold! (Applause)

Dr. Jos. F. X. Harold: Mr. W. S. Williams was Chairman of the Committee on Prizes and he has asked me by letter to make an announcement of the winners for the year.

There were four members on the Committee so that these prizes represent the votes of four: Dr. Scott, Mr. Williams, Mr. Knowland and myself, the first prize being awarded to the one receiving the greatest number of votes among the four, and so on.

A paper, "The Degumming of Silk," by Hugh H. Mosher, of the United States Testing Company, delivered before the New York Section, was awarded the first prize.

"Some Facts About Colloids," by Earl K. Strachan, Professor at Brown University, delivered before the Rhode Island Section was awarded the second prize.

The third prize was given to Dr. M. L. Crossley of the Calco Chemical Company for his article on "The Effect of Isomerism on Color," delivered before the Rhode Island Section.

The fourth prize was given to Mr. E. T. Davidson of E. I. du Pont de Nemours for his address, "Notes on Sulphur Dyeing," delivered before the South Central Section.

President Wood: You have heard these awards, gentlemen. We are very glad to have had Dr. Harold make this announcement at this time.

Mr. Cady I understand has a resolution to present to the Association.

Mr. Cady: This resolution was originally presented to the Council at a meeting during the fall and it was decided at that time to present it to the Annual Meeting for approval. I therefore offer it at this time:

Whereas, the splendid record of service to the American Association of Textile Chemists and Colorists by its founder and first President, Dr. Louis Atwell Olney, merits special recognition by the Association, be it

RESOLVED, That our founder and first President, Dr. Louis Atwell Olney, be designated President Emeritus of the American Association of Textile Chemists and Colorists and a life member of the Council.

The motion was seconded by several members and unanimously carried.

President Wood: Dr. Olney, it gives me great pleasure to announce that this resolution has been carried unanimously and I congratulate you. (Applause)

Dr. Olney: I can't express the customary surprise at this action because I got an inkling that something like this might happen in a report of the Council recently published. Nevertheless, I appreciate this great honor which has been bestowed upon me by the Association.

I shall have to admit that up to the present time my picture of a president emeritus has been that of a man who has rendered service in times past but who has outlived his usefulness (laughter), and that this is a rather humane way of disposing of him.

I trust that that is not the case at the present time and that I may still render a great many years of useful service to the Association.

Again I wish to thank the members for this honor, and I certainly look upon it as such. Thank you. (Applause)

President Wood: Gentlemen, before we adjourn this meeting I want to thank the few who still remain, which reminds me of a story of a man who was talking on a very dry subject, and the people dropped out one by one until finally there was only one man left, and he stayed another half hour. Finally, the man wound up his speech and he went down and shook hands with the man and praised him for his intellectuality and patience in staying to listen to his dry subject. The man said, "Oh, that's all right, I'm waiting to lock up." (Laughter)

The meeting stands adjourned.

The meeting adjourned at five o'clock.

FRIDAY EVENING TECHNICAL SESSION

The Tenth Annual Meeting convened Friday evening, December 6, 1930, at seven ten o'clock, at the Read House, Chattanooga, Tennessee, Dr. E. H. Killheffer, President, presiding.

President Killheffer: Gentlemen, please come to order.

The first subject for discussion this evening is, "The Newer Metals Employed in the Dyebath," and the discussion will be started by Messrs. McGinty and LaQue, representing the International Nickel Company.

Mr. F. L. LaQue: Your Chairman has mentioned that the subject of this symposium is to be a discussion of the newer metals in the dyeing industry. Whether or not the product of my company, Monel metal, is still to be called a "newer metal" is hard to state. However I believe there are on the program representatives of some of the steel companies. I refer to Mr. Hostettler, of the Allegheny Steel Company and Mr. Ewing, representing the Crucible Steel Company. I haven't seen either of these gentlemen about but I trust that they are here. They really represent companies offering new metals to the dyeing industry inasmuch as the stainless steels about which they will talk have only very recently come into general use and in this country; at least none of them have gotten into many dyehouse applications. Whether or not they will be usable in such work remains to be seen.

The paper which Mr. McGinty and I have prepared is not necessarily a discussion of metal and its properties. It is rather a discussion of a certain problem with which we were confronted, and, as I say, the problem with which this paper deals considers metal as only one of many factors and therefore it may not appeal to you as essentially a discussion of the properties of metals.

The title of this paper as you probably already know is, "Factors Involved in Single Bath, Degumming and Dyeing of Silk Hosiery." Mr. McGinty is the chemist at the Wiscasset Knitting Mills. I am with the International Nickel Company and was drawn into the prob-

lem for the reason that, lacking proof of what was the matter they (when I say "they" I refer to everyone who worked on the problem) came to the conclusion that the Monel metal involved in the processes was responsible for all the difficulties but that was proven to be erroneous as will be brought out.

. . . Mr. LaQue then presented his prepared paper . . .

Factors Involved in Single Bath, Degumming and Dyeing of Silk Hosiery

By L. J. McGinty* and F. L. LaQue**

**Chemist, Wiscassett Knitting Mills.*

***Development and Research Department, International Nickel Co., Inc.*

IN presenting this paper the authors do so, not so much because of the new data brought to light as in the hope that the method of attack on the problem presented may be of interest to those engaged in similar activities. In the case under discussion, the solution of the problem was the inevitable result of the application of well known scientific principles in their relation to the various factors involved. A similar method might be expected to afford a solution to many dyehouse problems and for this reason we shall trace the course of our activities from the presentation of the problem to its solution, even though at some points along the way we shall find that we have been led up blind alleys without progress towards the ultimate solution. Most of these false starts, however, were useful in indicating the necessity of considering some variable which had been neglected previously.

Nature of Problem and Its Final Solution

2. As presented, the problem was to determine why a different percentage of a certain dyestuff (Sulphon Cyanine Black B+) was required in different dyeing machines to produce the same shade on stockings knitted from the same batch of silk when they were degummed and dyed by the one bath method. The procedure was to enter the hosiery into the boiling bath containing the necessary dyestuffs and boil-off oil. Glaubers salt was added after 25 minutes and a sample taken out 15 minutes later. The actual time required to finish the dyeing depended on the degumming agent used and the accuracy of the formula.

3. The dyeing was done in standard rotary hosiery dyeing machines made of Monel metal and containing bronze gears and nickel silver heating pipes.

4. Table I shows the amount of Sulphon Cyanine Black B which was required to obtain the desired shade in each of six dyeing machines.

TABLE I

Characteristics of Various Machines
Sulphon Cyanine

Machine	Capacity	Age	Black Required	Remarks
1	100 lb.	3½ yr.	100%	Was most reliable and was used for bulk of dyeing.
2	100 lb.	6 yr.	110%	Diminished usuage appeared to be cause of extra black required.
3	100 lb.	1 yr.	110%	Subject to spells during which it required from 120% to 150% of black.
4	50 lb.	3 yr.	Thoroughly Unstable	Started with 150% usually required indefinite additions of black.
5	50 lb.	2 mo.	Thoroughly unstable	Started with 200% usually required indefinite additions of black.
6	200 lb.	1 yr.	140 to 175%	

5. It had been observed in the dyehouse that the strength of the black decreased between successive samplings when no additional dyestuff was added.

6. In a preliminary investigation in the dyehouse, it had been shown repeatedly that when the batch was degummed first and then dyed in a fresh bath, Sulphon Cyanine Black B behaved uniformly in all machines.

7. This indicated that the difficulty was associated in some way with the degumming process. Numerous batches were tried in which other degumming agents, including several soaps, were used in place of Degumming Agent X* which was in general use. The same amount of reduction was obtained in each case.

8. Then, it was contended that the metal in the machines was responsible in some way for the difficulties. There was no evidence to support this contention, which later was proved to be wrong. But the contention did lead to a thorough investigation which established that the amount of dissolved air in the dyebath was the elusive factor responsible for the difficulty. With this knowledge, gained through patient experiment, it was possible easily to preserve or largely to destroy the black in any of the six machines, at will.

+ See appendix for Trade Names of Dyes.

*A proprietary sulphonated oil containing sodium silicate.

9. The experiments leading up to the solution of the problem will be traced in the hope that the method employed may be helpful in the solution of other problems which temporarily may baffle the dyers confronted with them, and to show the importance of conducting careful and exhaustive experiments to establish the cause of such difficulties.

First Laboratory Experiments

10. The first step was to make laboratory dyeings in porcelain beakers with and without the addition of a Monel metal test piece. In all dyeings 1/8% Sulphon Cyanine Black and the customary amount of Glaubers salt was used. Parallel dyeings were made on degummed silk; also dyeings by the one bath process in which the degumming agents were soap (20%) and Degumming Agent-X (18%). There was not the slightest difference in the shade of any of these dyeings.

11. To study the influence of other metals used in the machines, additional dyeings (one bath) were made with and without the addition of test pieces of bronze and nickel silver, alone and in galvanic contact with Monel metal. As in the previous case, there was not the slightest difference in the shade of any of these dyeings.

12. Care had been taken in all tests to insure that the weight of goods, volume of liquid, area of metal test piece, etc., were in the same relation to one another as in the dyeing machines, and also that temperature and other factors incidental to the dyeing process were maintained properly.

13. Additional dyeings (one bath) were made in the presence of a Monel metal test piece, in which different amounts (5 per cent, 9 per cent, 13 per cent, 18 per cent, 25 per cent and 30 per cent) of Degumming Agent-X were used. These tests showed that neither 5 per cent nor 9 per cent Degumming Agent-X was sufficient to degum the silk, but beyond that they showed nothing of interest.

14. While these tests indicated very clearly that the metals did not affect the shade, they did not show why variable results were obtained in different machines in the plant. In the light of subsequent experiments, it is obvious that the factor (dissolved air) causing the trouble had not been controlled. One can appreciate easily that in beaker dyeings good penetration of air is assured because of the method of agitation which is used to obtain level dyeings.

Dyehouse Experiments

15. Having failed in the laboratory to determine the cause of the difficulties the scene of activities was shifted to the dyehouse.

16. All machines were examined carefully to establish that no other metals, such as iron, had been used in their construction which had not been included in laboratory tests. None were found.

17. Two lots of stockings were degummed and dyed; one in No. 1 machine, the other in No. 4 machine. The lot from No. 1 machine was satisfactory while that from No. 4 was decidedly yellower. This lot was stripped and redyed in a fresh bath in the same machine (No. 4) using the same amount of dyestuff. The desired shade was obtained. This showed that the elimination of silk gum eliminated the reduction.

18. In the next experiment a batch was degummed in No. 4 machine. The stockings were removed. Then the usual amount of dyestuff was added and mixed into the bath, which was sampled (sample A). Then the solution was boiled up (with the machine running) for the usual forty minutes and another sample (sample B) taken. By comparison it was evident that sample "B" had suffered considerable reduction. A duplicate test in No. 1 machine showed no reduction.

19. These experiments demonstrated three facts (1) that sericin was necessary to the reduction of Sulphon Cyanine Black B; (2) that the agencies responsible for reduction were active in the absence of the silk fiber itself and (3) that there was some factor peculiar to No. 4 machine which governed the degree of reduction of the dyestuff.

20. In attempting to learn more about this unknown factor, a typical degumming and dyeing bath was made up in both No. 1 and No. 4 machines which contained no goods. The bath was boiled up, salt added, etc., in the same manner as when actually dyeing. From each bath, a quantity of solution was taken for use in laboratory dyeings. These solutions would contain the normal amount of dissolved metals and it was thought that if the metals affected the dyestuff, it would be apparent from laboratory dyeings. Similar tests were made using separate degumming and dyeing solutions obtained in the same manner. In using these solutions, appropriate amounts of dyestuff and degumming agent were added respectively to the degumming and dyeing solution. In all these tests identical shades were obtained.

21. These tests established the absence of any effect from possible metallic contamination of the solution.

22. Therefore, it was concluded that any peculiar reducing property possessed by an individual machine was an attribute of the machine *as a machine* rather than of the metals of which it was constructed.

Temporary Method of Eliminating Reduction

23. Pending establishment of the actual cause of the reduction, an attempt was made to develop some practical device which would get around the difficulty.

24. It was decided first to study the influence of alkalinity of the bath. No. 4 machine was loaded and the goods degummed, using as a degumming agent 11½ oz. anhydrous soda ash, after which the goods were removed from the machine. The usual amount of dyestuff was

mixed into the remaining bath which was boiled for 80 minutes. Additions of 2 lbs. sodium carbonate and an indefinite quantity of sodium silicate were added after 40 and 60 minutes respectively. Samples were taken immediately after addition of dyestuff and again each time alkali additions were made, also at the end of the run. Comparison of samples showed progressive reduction of the black.

25. This test indicated that solutions of equivalent pH produced the same amount of reduction whether the alkalinity was derived from Degumming Agent-X soda ash, soap or what not. Also, it appeared that lower pH in the degumming solution should result in less reduction.

26. A batch was run in No. 4 machine using, in place of Degumming Agent-X, Degumming Agent-Y*, which was known to be less alkaline. As we had hoped, the black suffered no reduction. The use of Degumming Agent-Y gave consistently good results and proved to be an adequate temporary expedient.

Further Laboratory Experiments

27. Our work to this time indicated that the following factors governed the reduction of the black.

1. Hydrogen Ion concentration of solution or pH—High pH, high reduction.
2. Sericin—If degumming and dyeing were done in separate operations no reduction occurred in any machine.
3. Temperature—Experience had shown that if the temperature were kept low no reduction occurred. Actually this was not a practical solution to the problem, since when the temperature was kept low enough to prevent reduction of the dyestuff the penetration of the dye into the fiber was not sufficiently uniform or good, and degumming was retarded.
4. Sulphon Cyanine Black B—This was the dyestuff most affected. It also was considered to be the only dyestuff possessing the shading, stripping and fastness properties desired.
5. X—an unknown factor which remained to be developed and which was associated in some way with the machines as such.

28. Further laboratory work was decided upon in order to throw as much light as possible on the first three of the factors enumerated above in the hope of arriving at some means of evaluating the fifth or unknown factor. To facilitate this work, samples of typical boiled-off liquor were obtained from No. 1 and No. 4 machines after degumming batches using Degumming Agent-X. A sample of dye liquor of proper concentration was obtained by taking part of a dyeing solution (no Glaubers Salt) made up in one of the machines.

29. The degumming liquors from No. 1 and No. 4 machines were analyzed. Iron was the major metallic constituent and was somewhat higher in the sample from No. 4 machine which contained 9.8 parts per million. Otherwise the degumming liquors were identical. The effect of this extra amount of iron (2.6 P.P.M.) was shown to be negative by comparing laboratory dyeings using the solution from No. 1 machine with and without the addition of sufficient iron to bring its iron content up to 9.8 parts per million.

30. The solutions described in paragraph 28 were prepared for further use by adding the required amount of Glaubers Salt to the dye solution and then by concentrating both the dye solution and the boiled-off liquors by evaporating them to half their original volume. By mixing equal volumes of the concentrated dye solution and either of the boiled-off liquors a mixture was obtained containing sericin, degumming agent, sodium sulphate and dyestuff in the concentrations in which they were present in the dyeing machines at the plant.

31. The experiments described in Table II were then carried out, using as a container a one liter wide-mouth Erlenmeyer flask equipped with a reflux condenser. Where the presence of Monel metal is indicated it was added in the form of a sheet of Monel metal having an exposed area of 75 sq. cm. to which was attached a small piece of gear bronze. Metal salts were added where indicated in the form of standard solutions of the metal sulphates made up to contain one milligram of metal per cubic centimeter.

32. In considering results of experiments one to seven, it was evident that the presence of Monel metal and bronze or the ions of nickel, iron and copper had no influence upon the degree of reduction of the dyestuff.

33. From experiments eight to thirteen it was concluded that appreciable reduction would take place at pH=9.4 and that at pH 10.0 reduction was rapid and probably complete. The pH values were determined by adding specified amounts of 0.1 N sodium hydroxide to a mixture of 100 cc. of concentrated boiled off liquor and 100 cc. of water and by determining the pH colorimetrically. The methods of preparing the necessary indicator solutions and standards for the colorimetric determinations are outlined in the appendix.

34. Experiments thirteen to sixteen showed the effect of temperature on the degree of reduction occurring in a solution of pH 9.4 which at the boiling temperature would cause an appreciable reduction. These tests showed that little reduction would be expected at a temperature below 200°F.

35. In order to establish the importance of the sericin in the reduction reaction, 200 c.c. of dye solution was boiled for 40 minutes in the reflux apparatus with the addition of 10 cc. 0.1 N sodium hydroxide—pH 10.0. No reduction of the black was observed as was also the case when the Monel and Bronze sam-

*A proprietary sulphonated oil containing a very mild source of alkali.

ple used in experiments two and three (Table II) were included.

36. These experiments established the fact that the sericin itself and not the degumming agent was an essential factor in causing the reduction of the black. This conclusion checked plant experience where no reduction took place when the two bath process was used.

37. The most significant result of this series of tests was that it was found possible for the first time to produce reduction of Sulphon Cyanine Black B in the laboratory and furthermore that this reduction could be accomplished in glass vessels in the absence of any metal.

38. Considering these tests in conjunction with the first laboratory tests described earlier in the paper, it will be observed that the essential difference is in the degree of aeration of the solutions. In the one case the dyeings were made in open beakers under conditions insuring a high degree of aeration while in the other case the arrangement and operation of the apparatus was such that free access of air was prevented. It remained to be seen whether these aeration effects could be traced back to the machines in the dyehouse.

Investigation of Aeration Effects in the Dyehouse

39. To demonstrate the influence of aeration an attempt was made to accomplish reduction of Sulphon Cyanine Black B in No. 1 machine by reducing the amount of air dissolved in the dye bath. The most likely method of accomplishing this was thought to be by stopping the rotation of the cylinder, acting on the assumption that the splashing of the solution and the breathing action associated with the reversal of the direction of rotation of the cylinder would account for most of the air entering the solution. Accordingly, the goods were entered into the boiling degumming and dyeing solution containing 10 per cent Degumming Agent-X. The cylinder was rotated for 25 minutes and no reduction of the black could be detected. The cylinder was then stopped and the boiling continued for another 10 minutes. A sample taken after this relatively short time showed that considerable reduction of the black had occurred. Further reduction took place on continued boiling.

40. Having shown that No. 1 machine could be made to cause reduction of the dye by decreasing the degree of aeration, it remained to be shown that manipulation of the same factor in No. 4 machine would eliminate reduction of the black. Air was injected into the solution from an air compressor through one of the perforated steam pipes in the machine which was then loaded in the usual manner. The lot was processed using Degumming Agent-X as the degumming agent. During the operation, air was kept bubbling through the solution. An examination of the dyed stockings showed that no reduction had occurred, in fact the shade was blacker than usually obtained with the formula when used in No. 1 machine.

41. In later experiments it was found that only a very small amount of air was required to prevent reduction of the black. In view of the very low solubility of air in the solution near its boiling point it was not strange that only minute quantities were required to keep the solution saturated. It was quite probable that only oxygen in actual solution had any effect in preventing reduction of the dye.

42. The same results were obtained consistently in numerous subsequent tests which served to establish def-

TABLE II

Exp.	Ingredients Boiled-off Liquor Volume	Machine	Dyestuffs Solution	Additions	pH	Temp. °F.	Time Min.	Reduction in Color of Solution
1	100 cc.	No. 4	100 cc.			212	40	Very slight
2	100 cc.	No. 4	100 cc.	Monel & Bronze		212	40	Very slight
3	100 cc.	No. 1	100 cc.	Monel & Bronze		212	40	Very slight
4	200 cc.	No. 4	100 cc.			212	40	Very slight
5	100 cc.	No. 4	100 cc.	10 mg. Ni		212	40	Very slight
6	100 cc.	No. 4	100 cc.	10 mg. Fe		212	40	Very slight
7	100 cc.	No. 4	100 cc.	10 mg. Cu		212	40	Very slight
8	100 cc.	No. 1	100 cc.	20 cc.O.1N NaOH		212	40	Great
9	100 cc.	No. 4	100 cc.	10 cc.O.1N NaOH	10.0	212	40	Great
10	100 cc.	No. 1	100 cc.	10 cc.O.1N NaOH	10.0	212	40	Great
11	100 cc.	No. 4	100 cc.	5 cc.O.1N NaOH		212	40	Less than in test 10
12	100 cc.	No. 4	100 cc.	1 cc.O.1N NaOH		212	40	Slight
13	100 cc.	No. 4	100 cc.	2 cc.O.1N NaOH	9.4	212	40	Considerable
14	100 cc.	No. 4	100 cc.	2 cc.O.1N NaOH	9.4	180	40	Very slight
15	100 cc.	No. 4	100 cc.	2 cc.O.1N NaOH	9.4	200	40	Slight
16	100 cc.	No. 4	100 cc	2 cc O.1N NaOH	9.4	205	40	Appreciable

initely that the amount of dissolved air in the dye bath was the elusive factor responsible for the erratic behavior in different machines. Indeed it was found that if an adequate quantity of air were supplied to the bath, all the other factors could be varied at will without harmful results so far as the dyestuff was concerned.

INVESTIGATION OF pH OF DEGUMMING SOLUTIONS

43. As a matter of general interest colorimetric determinations of the pH of degumming solutions were made to determine why Degumming Agent-Y could be used successfully under conditions where Degumming Agent-X produced reduction of the black.

44. A degumming bath containing 10 per cent Degumming Agent-X was prepared in No. 4 machine; its pH was 9.7. The bath was used for degumming a lot of goods after which its pH was 9.5. A similar test carried out in No. 2 machine gave pH values of 9.8 and 9.2 respectively. Another test in No. 1 machine gave pH values of 9.8 and 9.5 respectively.

45. In comparing the performance of the two degumming agents a degumming bath was made up in the No. 4 machine using 20 per cent Degumming Agent-Y. The pH of this solution was 9.2. The usual amount of goods was added to the boiling solution. During the degumming operation the pH was measured at intervals of 10, 20, 30 and 40 minutes, the pH values obtained being respectively 8.8, 8.6, 8.3 and 8.3. Another bath made up with 10 per cent Degumming Agent-X had an original pH value of 9.5 which dropped during the first 15 minutes of degumming to 9.3 and in 30 minutes to 9.2 where it remained for the rest of the degumming operation. The relative behavior of the two degumming agents is shown graphically in Plate I.

46. Since it was shown in the laboratory that very little reduction would occur in solutions of pH lower than 9.4 it was quite evident why Degumming Agent-Y could be used safely where Degumming Agent-X would produce reduction.

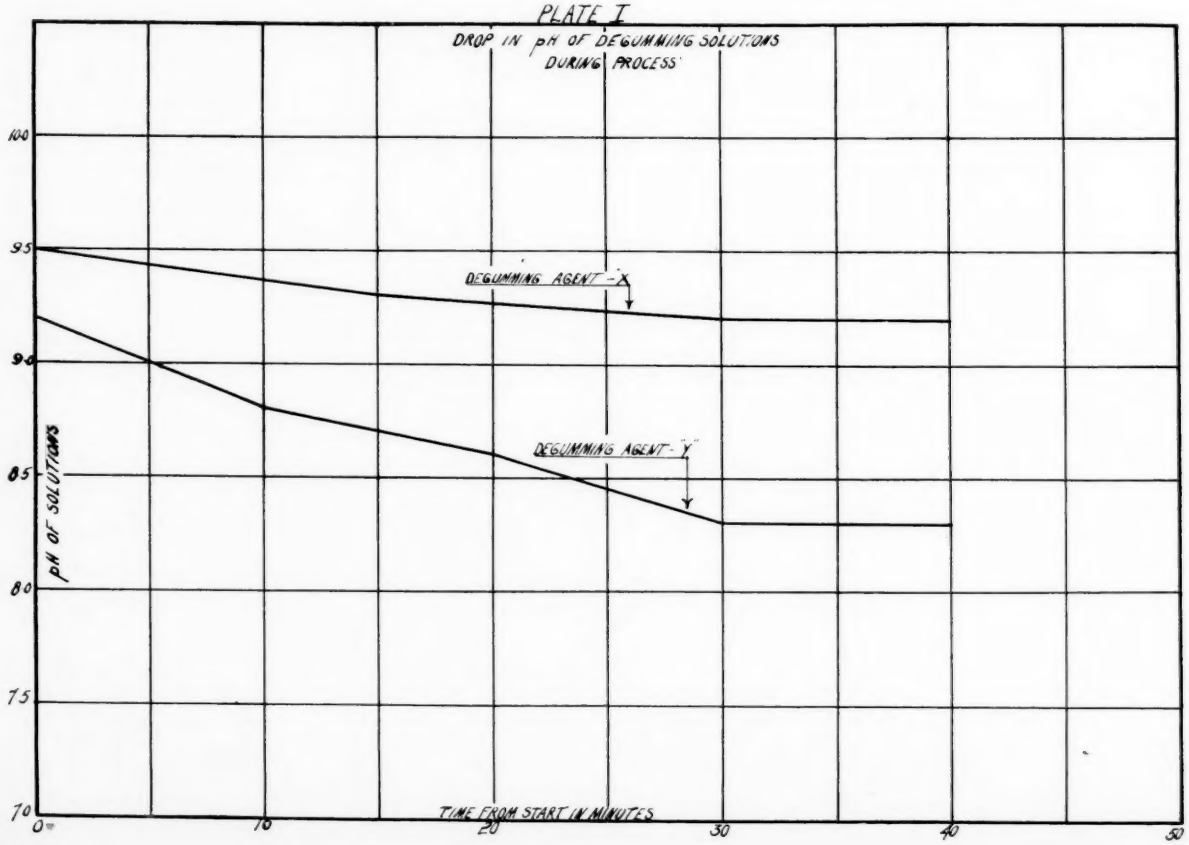
CONCLUSIONS

47. As a result of the investigation it was evident that the following factors influenced the reduction of Sulphon Cyanine Black B.

1. Sericin
2. Aeration
3. pH or alkalinity
4. Temperature

They may be discussed briefly as follows:

PLATE I



1. Other conditions being favorable for reduction none will take place in the absence of sericin—silk gum. But as presence of silk gum in the dyebath is an essential part of the single bath process it cannot be considered a controllable variable.
2. Reduction may be prevented or controlled by aerating the solution. Rotary dyeing machines designed for compactness and for prevention of excessive steam in the dyehouse atmosphere ordinarily cannot be depended upon to insure sufficient air in the solution to prevent reduction when other conditions are favorable for its occurrence. There is usually sufficient outward pressure of steam in the machine to prevent access of air to the solution except for that brought in by the slight breathing action due to the motion of the revolving cylinder; even the effectiveness of this breathing action may be diminished or largely eliminated in machines with good tight joints above the liquid level and closely fitting doors. The necessary supply of air can be specifically provided for by equipping the machines with auxiliary apparatus in the form of air pumps or other aerating devices designed for the purpose.
3. The use of degumming solutions having a pH lower than the critical value of 9.4 would eliminate the reduction of the dye. Until a degumming agent is developed which will be effective at a low pH, it will be necessary to provide for the use of degumming solutions above this critical pH value by controlling the other factors. Since the pH of degumming solutions drop on an average of 0.5 during operations it is advisable to start with a solution having a reasonably high pH so that the normal drop during the first few minutes will not leave a solution whose efficiency in degumming has been seriously impaired.
4. Since no reduction will occur at temperatures below 203° F. it would seem advisable to conduct the dyeing operations at as low a temperature as possible. However, it is difficult to degum silk properly and to get an even penetration of dyestuff at a low temperature. It might be possible to modify the ordinary procedure by keeping the temperature below the critical limit until the pH of the degumming solution has dropped in the usual manner to a value below 9.4 after which the temperature could be raised to the boiling point and the dyeing completed without danger of reducing the color.

48. It has not been common practice to pay much attention to the effect of air in the ordinary dyeing processes, except, of course, in connection with those well known classes of dye where the final color is secured by oxidation following the application of dyestuff to the goods. Possibly this factor should be controlled more generally in dyeing operations. Likewise more attention to hydrogen ion concentration may eliminate some of the guess work associated with rule-of-thumb practices in the application of color to goods.

49. Attention is drawn to the effect of sericin on the reduction of Sulphon Cyanine Black B in the hope that color technologists will become sufficiently interested to subject the point to further study.

50. As a matter of information, patents are being applied for covering the introduction of air to dyeing solutions and devices therefor. Application for patent is merely for the protection of the textile industry to prevent any one manufacturer from obtaining sole control of this improvement.

51. The authors wish to acknowledge with thanks the co-operation and suggestions given them by their colleagues in carrying out the considerable amount of work involved in this investigation. In particular, mention should be made of the help given by Mr. C. W. Gaddy, Superintendent and Manager of The Wiscassett Mills, Mr. W. A. Holst, Jr. of the New York Laboratory of the National Aniline & Chemical Company, Inc. and Mr. R. J. McKay, Mr. H. E. Searle and Dr. W. A. Wesley of The International Nickel Company, Inc.

Appendix

TABLE I

Trade names of typical Sulphon Cyanine Black B dyes—Schultz No. 265, Colour Index 307.

Name	Manufacturer
Aceko Milling Black G.D.	John Campbell & Company, 75 Hudson Street, New York City.
Aceko Milling Black N	John Campbell & Company, 75 Hudson Street, New York City.
Acid Milling Black	Geigy Company, Inc., New York City.
Durol Black B	National Aniline & Chemical Company, 40 Rector Street, New York City.
Durol Black BA	National Aniline & Chemical Company, 40 Rector Street, New York City.
Durol Black 2B	National Aniline & Chemical Company, 40 Rector Street, New York City.
Cloth Silk Black 2BN	Ciba Company, Inc., New York City.
Pontacyl Fast Black BB	E. I. DuPont de Nemours & Company. Wilmington, Delaware.
Pontacyl Fast Black BBO	E. I. DuPont de Nemours & Company. Wilmington, Delaware.

Sulphon Cyanine Black BA—General Dyestuff Corporation, 230 Fifth Avenue, New York City.

Sulphon Cyanine Black 2B—Chemical & Dye Corporation, Springfield, New Jersey.

Sulphon Cyanine Black J—General Dyestuff Corporation, 230 Fifth Avenue, New York City.

Sulphon Cyanine Black JB—General Dyestuff Corporation, 230 Fifth Avenue, New York City.

Measurement of pH

(See paragraph 34)

In the laboratory, determination of the hydrogen ion concentrations of the various solutions presented some difficulty. The solutions contained considerable quantities of reducible organic matter which probably would have prevented the use of a hydrogen electrode, they were too alkaline for the successful employment of quinhydrone and too highly colored and turbid to permit ready determinations by colorimetric methods. Approximate values of the pH were obtained by making up solutions from the degumming solutions alone (free from dyestuffs) using thymol blue and thymolphthalein as indicators. Suitable color standards were not available commercially for the pH range desired so these were made up in the laboratory as described below. In this way values sufficiently accurate for the purpose were obtained without taking the time to determine the applicability of glass electrodes. In making these determinations we were guided by reference to "The Determination of Hydrogen Ions" by Mr. W. M. Clark published by Williams & Wilkins, 1928 edition.

Indicator solutions were made up according to Table II.

TABLE II

=INDICATOR SOLUTIONS

Name	Concentration by weight	Solvent	pH Range	Color Change
Phenol Red.....	0.04%	Distilled water	6.8-8.4	Yellow to Red
Thymol Blue.....	0.04%	Distilled water	8.4-9.2	Yellow to Blue
Thymolphthalein ..	0.04%	50-50 ethyl alcohol and water		Colorless to Blue
*Mixed Indicator..	0.04%		10.3-13.0	Yellow-Green-Blue Violet

These particular indicators were selected because other possible indicators gave color changes in the yellow orange range which could not be distinguished from the natural color of the degumming solution.

*Mix Tropaeolin 0 (1 part) Thymolphthalein (4 parts) to give 0.04% solution in 50% ethyl alcohol.

For the phenol red and thymol blue indicators the color of the solution being tested was compared with the other chart on page fifty-two of the reference book mentioned above.

For the thymolphthalein and mixed indicator, standard solutions were made up. Thymolphthalein fades rather rapidly in alkaline solutions so that it was necessary to make up fresh standards just before they were required. In preparing the standard solutions two solutions of different alkalinity were prepared as follows:

1. Solution "A" made up to contain exactly 5.3 grams of Na_2CO_3 per liter.

2. Solution "B" made up to contain exactly 19.1 grams of $Na_2B_4O_7 . 10H_2O$ per liter.

These solutions were mixed in the proportions shown in Table III to give solutions of the various pH values.

TABLE III

STANDARD SOLUTIONS

Solution "A"	Solution "B"	pH
0.00 cc.	100 cc.	9.2
35.7 cc.	64.3 cc.	9.4
55.5 cc.	44.5 cc.	9.6
66.7 cc.	33.3 cc.	9.8
75.4 cc.	24.6 cc.	10.0
82.15 cc.	17.85 cc.	10.2
86.9 cc.	13.1 cc.	10.4
91.5 cc.	8.5 cc.	10.6
94.75 cc.	5.25 cc.	10.8
97.3 cc.	2.7 cc.	11.0

The mixed solutions were kept in clean 100 cc. glass stoppered bottles labelled with the proper pH value. In using the indicators 0.5 cc. of indicator solution was added to 10 cc. of the standard solution or to the same volume of the unknown.

Mr. LaQue: As a matter of information, patents have been applied for, covering the introduction of air into dye baths, not because we have any selfish motive in the matter but because we want to make it free to all. We do not want any firm to patent the idea and deprive everybody of its use, if it should prove useful on a practical scale. Therefore, although we have applied for a patent we do not mean to use it to prevent the use of aerating devices, but rather to favor their use.

Mr. McGinty is here and if there are any questions concerning the dyehouse end of this problem he will be glad to discuss them with you.

Thank you. (Applause)

Mr. Walter E. Hadley: I should like to ask if any experiments were made using a little hydrogen peroxide.

Mr. LaQue: I tried that. I didn't use sodium peroxide—I was afraid it was too alkaline. I did try some sodium perborate.

The sodium perborate might be expected to behave as an oxidation agent in alkaline solution, but it didn't. It served only to break up the degumming agent and precipitate the greases onto the fiber. It didn't work satisfactorily although that would appear to be an ideal way of getting the oxidizing power. We didn't, as I say, try sodium peroxide.

Mr. Johnson: Was there any suggestion in any of the experiments that the action of the throwing oils used in preparing the silk had any effect on the ultimate dyeing?

Mr. LaQue: Mr. McGinty can tell you more about that than I can.

Mr. McGinty: I don't think there was any evidence of that at all.

Dr. E. W. Pierce: There is a phenomenon I observed about six or seven years ago when I was running a steady job dyeing hosiery and it surprised us very much.

We got a brand new Monel metal machine and it ran for two or three weeks. We degummed in it and dyed in another machine. Suddenly the inside of the machine turned dark, like gunmetal. On the first lot it didn't make any difference. On the second lot, it rubbed all off on the goods.

We got some of the deposit off and sent it to the laboratory. It was pronounced copper sulphate. To clean up the machine we had to put a hypochlorite solution in it and ever afterward when we made a boiloff which consisted of hydroxyl oil and sodium chloride we would have to put in a dipper of hydrogen peroxide. The sulphur coming from the sericin of the silk acts on the copper in the Monel metal, which has a reducing action on dyestuffs, and if the peroxide were not there it would affect the dyes very strongly.

We boiled off first and dyed in a separate bath. That may have some bearing on your problem: the formation of copper sulphate as an intermediate in this operation.

Mr. LaQue: We pretty conclusively demonstrated that metal was not a necessary factor in the reduction of Sulphon Cyanine Black B. It may, as you say, have been a contributory factor, but it was possible to prevent any effect of the metal, if there were one, by control of the factors, and it was also possible to produce reduction in the absence of metal, and I must say that we never noticed any tarnish on the metal in the machine.

Dr. Pierce: That would explain the necessity of air to keep up the oxidation. It would also explain the dropping of pH.

Mr. LaQue: It is quite possible to form copper sulphide on Monel metal in the presence of oxidizing agents, and I wouldn't, offhand, expect the presence of an oxidizing agent of itself to prevent the formation of sulphides of nickel and copper from Monel metal if other conditions were favorable to their formation.

Dr. Pierce: But copper sulphide will oxidize to sulphate by air oxidation. That is used in printing Aniline Black.

Mr. LaQue: We have used that oxidation of sulphide of Monel metal to clean it up. In other words, if we want to clean up the sulphide resulting from the improper use of stripping agents we advocate the use of sulphuric acid made slightly oxidizing with hydrogen peroxide, and that is a true thing. It is possible to convert copper sulphide to copper sulphate by oxidizing in the presence of an acid, but in the presence of alkali it seems rather too much, from my experience to digest. Of course, my experience has been limited.

Dr. Pierce: I am wondering if anyone else has observed that.

Mr. LaQue: I haven't had it drawn to my attention. Mr. McGinty has had those machines for six years and he knows about those things. Perhaps he can enlighten you.

Mr. McGinty: I can say we have noticed that new machines have always been worse in reducing Sulphon Cyanine Black B. I suppose that is because the joints are tighter and there is less access to the air than in the old machines.

Mr. LaQue: Of course, that is a factor to be considered.

President Killheffer: Are there any further questions? If not, the next paper is "Fabrication of Chromium-Nickel-Iron Alloys," by Mr. J. S. Ewing, representing the Crucible Steel Company of America.

Fabrication of Chromium-Nickel-Iron Alloys

By J. S. Ewing

Crucible Steel Company of America

I OWE you gentlemen somewhat of an apology. My knowledge of your industry is limited to a very brief exposure to elementary organic chemistry that fortunately or unfortunately all metallurgists have to take. That knowledge which I acquired was very sketchy and has been entirely forgotten. For that reason I am limiting my entire talk to the metals themselves.

Almost everyone that introduces a speaker on this subject gives our products the name of "stainless steels." "Stainless" is a very broad term which covers this entire class of alloys, which includes both straight chromium steels and chromium-nickel steels. The talk this evening will be limited to the chromium-nickel alloys, and this in itself is a very wide field.

The alloys will run in composition anywhere from eight to thirty-six per cent nickel and from ten per cent to as high as thirty per cent chromium. This is merely a start, and with the development of the newer modifica-

tions of the older alloys we are adding molybdenum, tungsten, and appreciable amounts of silicon.

In order to make the talk fairly clear I am going to limit myself to just one of this broad class of alloys. In order to prevent confusion I am going to stay away from trade names for that is a rather common error that everyone gets into. (Applause)

The alloy in question is the well-known eighteen per cent chromium, eight per cent nickel, which we can say is the nearest approach to the ideal that we have ever located. It is a long way from that but it will meet a wider class of conditions more economically than any of the rest.

The steel is austenitic in character. That means that it does not behave like the ordinary steels with which you are familiar. It is non-magnetic. Instead of becoming harder when quenched from a high temperature it becomes soft. In fact, to get it into its most ductile condition we quench the material from an extremely high temperature. The strength of the steel, despite this softness, is approximately double that of ordinary flange steel or boiler-plate. The physical properties will run somewhere in the neighborhood of 90,000 lbs. per sq. in. tensile strength, about 45,000 lbs. per sq. in. yield point, with an extremely high elongation, around fifty per cent, and an even higher reduction of area of about seventy-five per cent. The latter two figures will give you some line on the ductility of the alloy.

The steel has many peculiarities compared with ordinary steels. Among them is the fact that it can be hardened only by cold work and with this cold working it hardens much more rapidly than the ordinary steels.

The material is available in practically every form that you can buy the ordinary steels; that is, bars, plates, sheets, strips, tubing, castings, and forgings.

I will go over briefly the salient factors in the fabricating.

Naturally, with the additional strength at room temperature, plus the fact that these alloys all retain a much larger degree of their original strength at high temperatures than does mild steel, they are much harder to form or forge hot into required shapes. This includes the work that must be done on tubes, such as expanding, belling, or flanging. You must go to a much higher temperature than you would with mild steel. In addition to this you will probably have to re-heat two or three times, due to the fact that the hot working range is much smaller than in mild steels. This range will run from approximately 2150° F. to 1750° F.

The matter of welding is one which everybody is interested in because it is one of the easiest means of fabricating a finished vessel. I can safely say that the material can be welded by every method except hammer welding. That is, it can be arc welded, gas welded, resistance welded, or spot welded.

The arc welding of this material requires a special technique. Briefly, it requires a reverse polarity; that is, your electrodes should be positive and your work negative. The essential factor in welding, naturally, is to use an electrode or a welding rod of the same analysis as the material itself. In this case of course it would be eighteen chromium, eight nickel rod.

The weld must always be cleaned after the welding operation is finished, for there is always a scale deposit which will tend to corrode unless removed.

The material can be soldered or brazed. I say this with a great deal of caution because we do not recommend the brazing of it. The soldering is satisfactory as far as obtaining a liquid-tight or air-tight joint is concerned. In order to obtain strength in your soldered joint, it is advisable to spot weld the material before soldering.

In the shearing and punching of it, which every shop runs across, you must remember that despite the metal's strength the material is very ductile and will tend to slip and not shear off clean or punch clean unless precautions are taken. These precautions in the words of the shopmen mean that your shears must be set somewhere closer or, in a punching operation, your dye clearance must be much closer.

Considering drilling, tapping, milling and machining, there you are dealing with a steel which is somewhat on the order of the thirteen per cent manganese steel. In other words, despite the extreme softness, it is extremely tough and dense and the ordinary carbon tool steels or alloy tool steels will burn up very rapidly. It is necessary to use a high speed steel with special clearances, rakes, and angles on the tools depending on the type of work for which it must be used. The speed of the operation must also be diminished.

The forming or drawing of the material can be handled very readily. This is evidenced by the extremely high reduction of area and elongation that the metal has. It must be remembered though, that the alloy has approximately twice the strength of your mild steels, which means it will require just twice as much pressure or power in order to do the necessary operation.

You must add to this the fact that the material hardens very rapidly in an operation of this sort and if you have an extreme drawing operation to undergo it is necessary to stop perhaps two or three times and anneal.

Lubricants enter into the matter of drawing and forming very strongly. Your finished result will depend somewhat on these.

The material can be welded to ordinary steel without any signs of electrolysis. Covering that subject very hurriedly we can say as a general rule that it is electro-

negative to aluminum and iron and most of their alloys and is electro-positive to copper and most of its alloys.

The matter of correct type of alloy to be used is going to depend on several factors: first, your problem, naturally; second, whether or not you merely desire something which is corrosion-resistant or something which is absolutely stainless.

I believe from what I have read about your industry and what little I know about it that it is practically a necessity to have an alloy which is not attacked at all by any of your solutions. Due to this I believe you will find that there will be another factor entering into the matter and that is the one of finish. Practically all of these alloys have a definite ratio of corrosion depending on the degree of finish that is on the finished article. In other words, an ordinary finish, or mill finish as we call it, will probably be satisfactory for the majority of the industries that we have contacted so far. As you go up the line and desire alloys that become more and more resistant to that corrosion until the corrosion reaches a negligible quantity, it is mostly always necessary to have a highly polished finish. (Applause)

President Killheffer: Are there any questions that you would like to ask regarding some of the applications that have been referred to?

The next speaker, according to the program, is to tell us something of the chemical properties and uses of this same character of alloy, chromium-nickel-iron, Mr. L. W. Hostettler, of the Allegheny Steel Company.

. . . Mr. Hostettler not being present, his paper, "Chemical Properties and Uses of Chromium-Nickel-Iron Alloys," was read by title. . . .

President Killheffer: I see by the green printed program, which I believe was put out by the local section, that we are now to have the pleasure of an address by Dr. C. E. Mullin, of Clemson College.

. . . Dr. C. E. Mullin presented a prepared paper entitled, "Textile Conditions and Processes Abroad" . . . (Applause)

Textile Conditions and Processes Abroad

By Prof. Chas. E. Mullin, D.Sc.,
Professor of Chemistry, Rayon and Dyeing
Head Division Textile Chemistry
Clemson College, S. C.

MR. KELLY, Chairman of the Arrangements Committee, suggested that I speak upon Textile Conditions and Processes Abroad. Before discussing this subject I wish to correct the impression that everything is done better abroad than in America. Some people seem to have absorbed this impression from some of my previous remarks at various times. This was probably due to the fact that I have generally discussed the things which they do best abroad. My only explanation for this is that I believe you are generally more interested in learning how to do things better, rather than to be patted on the back and told how good you are. Tonight I am going to point out some of the things that are done better in America than in Europe.

There are many reasons why we are able to do certain things better in America than they are ordinarily done in Europe. America is a newer country. Our forefathers were progressive; progressive enough to come to the new country, America, and succeed in their chosen lines of endeavor. Our ideas along many lines are more progressive than those of our neighbors abroad, and we are not hampered by precedent to the same extent as in some of the older countries. On the other hand, our textile industry has probably not been as progressive as some of our other industries, but we hope for improvements along this line in the near future.

America has another tremendous advantage in the matter of the price of our manufactured goods. *In no other part of the world is there the demand for high quality goods, such as exists in America.* As a general rule, our clothes and other textiles cost a little more money than those manufactured and sold abroad, but they are of better quality and it costs more to manufacture them. They give better service and are fully worth the price. In no other country does the general public dress half as well as in America, nor spend nearly as much money for clothes.

The synthetic yarn industry is an excellent example of this. In no other country in the world is the bulk of the rayon and other synthetic yarn equal to that in America. This statement applies not only to the yarns but also to the woven and knit fabrics. It is true that our yarns cost a little more, but a good article is worth all it costs, and our synthetic yarn fabrics are equal to any in the world, and far surpass most of those produced abroad.

At the same time, I do not want you to believe that we lead in everything. *Europe leads us in textile research so far that it will take us a long time to catch up.* This research abroad is entirely supported by the government and the textile industry. The various employees' associations take no part in it.

General Conditions in the Textile Industry Abroad

Before going into the chemical side of this subject, which I know is particularly interesting to the men here tonight, I will say a few words upon the general textile conditions of Europe. I believe that the textile industry of France today is running better than that of any other part of the world. This also applies to most of the other French industries. Probably Belgium, Czecho Slovakia and Germany are about equally active but not nearly as busy as the French plants. Conditions are not so good

in England, and they are considerably worse in Italy. This applies particularly to the spinning and weaving industries.

In England the bleachers and dyers have formed an association and have regulated their charges in such a way that even though the other parts of the industry do not make any money, the bleachers and dyers manage to survive. Of course the other branches of the industry are having a lot to say about this, but it would probably have been a great deal better for the spinners and weavers if they had followed the lead of the finishers, and held up their own prices, instead of killing all business by cut-throat competition. Several years ago I made a considerable study of the textile industry in England and I will give you some idea of my impressions at that time.

As you all know, before the war, England was the greatest exporter of textile materials in the world. She exported enormous quantities of cheap cotton goods to China, India, Japan, Russia, Africa, and many other countries. She even exported a large amount of the better quality goods to America. After the war she lost her markets and, although I have never seen any exact figures regarding the total capacity of the English textile plants for production, I believe that the combined production capacity of the English plants must have been at least five times, and perhaps ten times, the English domestic capacity for textile consumption.

Just as in America, every English plant manager likes to see his plant operating to capacity. In order to get the business necessary for this full time, or even part time operation, it was considered necessary to cut prices. It was this competition on the part of almost all of the English plants that put the price of textiles to the point where only a very few plants managed to survive. You all know that business without profit is absolutely ruinous, and probably worse than no business at all, as it takes the business away from some other plant that might make a profit out of it. The result was that many of the English plants lost so much money that they were either in the hands of the banks, or were carried along by the banks for the reason that it was not worth while to take them over. On top of all this are the high English taxes, due to the doles to the unemployed, etc., and the restrictions in the management of the plants by the labor.

The German Dyestuff Industry's Example

At the close of the war, the Germany dyestuffs industry found itself in a very similar position, in that it had a tremendous production capacity but had largely lost its export markets. Instead of cutting each others' throats with ruinous competition, the Germany plants consolidated and cooperated, went in for research along other lines, and today in many respects are probably stronger than ever before. It is very probable, however, that at present most of the profits in the German dyestuffs combine are made from products other than dyestuffs. Many of these are the result of research since the war.

The English textile manufacturers are now beginning to follow the German example of consolidation and cooperation. In some cases this only amounts to cooperative buying and selling, the exchange of technical information, etc., but even this is a step in the right direction and I am very glad to see that there are signs of more of this in America.

One of the results of the English cooperation has been the establishment of the finest textile research laboratories in the world. These are financed cooperatively by the textile mills and the government. Although the results of this research have not yet met the impatient expectations of many men in the textile industry, this is due to the vast amount of fundamental research necessary as the foundation for further research and solid development.

I think you all know what the result of an over-capacity for production and the resulting competition has been in England, and we are only too familiar with something of the same sort here in America. Let us hope that it will go no further here and that American production will be restricted voluntarily to the point that ruinous competition will be avoided. It is unfortunate that all American manufacturers have not been able to study the textile situation in England.

Some Progressive Plants Are Busy

Right here I wish to point out a fact that was called to my attention by a friend in New York upon my return from Europe this fall. This friend is quite close to all branches of the textile industry and he pointed out that quite a few of the most progressive textile plants were still running very well in spite of the depression. In every case he mentioned, the plants were using synthetic yarns in some way, were very progressive, up-to-date, *and had the best designers available*. As this friend is in the rayon industry, he is better acquainted with the plants using rayon than those not using it, and there may have been quite a number of plants running just as well that were not using rayon. On the other hand, I have found that the European plants using some synthetic yarns in connection with their fabrics, as a class, are busier than the plain cotton or wool goods plants.

Just how much is a man who can keep a plant going to capacity worth to a company? It is pretty hard to estimate this value but, like the rooster that rolled home the ostrich egg as an incentive to the hens, it's something for every man here to aim at, and I hope he hits the mark. The ability to do this is connected with the imagination and vision necessary to visualize and develop new materials, processes, methods, and products. It is also necessary that the man who is going to have these ideas, and apply them, have the time, technical assistance, and apparatus at his disposal to run the experiments necessary in the de-

velopment of these ideas. Too many American plants keep their best men so busy on production and routine work that they never have a chance to follow up and develop new ideas. One new idea, properly applied, may be worth far more than a year's routine work by the same man.

Dr. Mullin then discussed many of the chemical processes, methods and equipment used in the textile industry in England and Europe, and compared these with the American practice.

In closing I wish to say that many things are very well done in Europe. Many things are also very well done in America and, on the whole, I believe that the American textile industry is equal to any in the world. At the same time I am sure that it is possible to greatly improve the American methods and equipment. We have a tremendous advantage in America in that our major demand is for a far better grade of goods than the bulk of the English and European demand. It is true that at the present time there is a very decided demand for, and a tendency towards, a lowering of prices; but this demand is for lower prices on processes and materials of our standard quality, and not of the grades so largely used in the countries with lower standards of living.

For many years England led the world in the production of almost all qualities and grades of textile materials, but at the present time almost all of these materials for the American trade are made in America. Due to our higher labor costs, in most cases the cost of production in America is considerably higher in America than in England or Europe. This is particularly so in the case of very finely spun yarns and fabrics woven from them, Turkey red dyed cottons, etc., where the labor involved is the principal item of cost. On the other hand, where the materials can be made almost entirely by machinery, such as the fabrics woven from coarser yarns on the automatic loom, it is possible to produce these even more cheaply in America than in England, and some of these American-made materials have actually been exported to England within recent years.

Today England is leading the world in textile research. Germany is also doing a great deal more than America along this line. There is no doubt whatsoever that there has been a great change in the attitude of the American textile industry towards technical men in the last ten or twenty years. Now the change in attitude towards textile research is very apparent and it won't be long before American textile research will be fully equal to that of any other country in the world.

President Killheffer: I am sure that we have enjoyed very much this address of Dr. Mullin's. When he referred briefly at the beginning of his remarks to the rather depressed condition of the textile industry in the United States it reminded me of the story they were telling a couple of years ago—probably not a couple of years, but some time ago—of a New England mill man who was sitting in his library at home one evening reading a newspaper and smoking his pipe. His little boy was doing his home work over at the desk. Apropos of nothing at all he turned around and said, "Pop, how many mills make a cent?"

The old man pulled his pipe out of his mouth and said, "Not a damn one." (Laughter)

Mr. White: Mr. President, Dr. Mullin made a statement that I can't let him get away with. He made the statement that he found the workmanship in textiles in Italy inferior to that in France. Perhaps Dr. Mullin didn't look around sharply enough and didn't see the good workmanship in Italy. (Laughter and applause)

ANNOUNCEMENTS

President Killheffer: There are a number of other items on the program for this evening and many of them, I know you will be very sorry indeed to hear, we will have to read by title and publish because the gentlemen who were to present the papers are not here.

I don't think Mr. Zisman is here, so we will read his paper, "The Delustering of Silk Hosiery" by title and publish it.

I don't think Dr. Snell is here so we will read his paper, "The Process of Silk Soaking," also by title and publish.

Mr. Durfee is not here either. His paper, "Numerical Solubility of Dyes," will be read by title and published.

We will ask Mr. Price of the Celanese Corporation to present his paper on "Construction of Celanese Fabrics as Related to Dyeing and Finishing Methods." I am sure that this will be very interesting indeed and we should give him our careful attention.

. . . Mr. Harry Price presented his prepared paper. . . .

Construction of Celanese Fabrics as Related to Dyeing and Finishing Methods

By HARRY PRICE

Celanese Corporation of America

ALTHOUGH Celanese has been discussed at your National and Sectional meetings many times in the past, it still, apparently, presents itself as an interesting subject, and while many of us like to think that we know a great deal about it, there are, undoubtedly, many points in connection with the dyeing and finishing of Celanese still to be learned by even the best informed. Hardly a week passes that the Celanese Corporation does not receive a number of requests from various dyehouses for

information concerning its processing. The time allotted for this discussion is short, only one half hour, but I shall try to crowd into that brief period as much information as possible and still have a few minutes for questions which, I am sure, some of you will want to ask.

A few words about the growth of the synthetic textile industry as a whole and the development of Celanese seems worthy of mention. The importance of the synthetic textile industry is probably best indicated by the comparative production figures of 1910 and 1929. The world's production in 1910 is reported to have been about 8,000 tons, and in 1929, about 200,000 tons. The production in the United States is officially recorded as 700 tons in 1913, 11,000 tons in 1922, 23,500 tons in 1925, and was probably about 70,000 tons in 1929. In other words, here in the United States the production in sixteen years has increased by about 10,000 per cent and it is still increasing. A rather bold prediction was not long ago made by one writer that the world's production of synthetic fibers would, by 1935, reach 2,500,000 tons, and by 1940, 5,000,000 tons.

There are, as you know, four general or important processes used in the manufacture of synthetic fibers, namely:

1. Celanese—Cellulose Acetate
2. Viscose
3. Nitro cellulose
4. Cuprammonium

and as the general methods of production under each of these processes have often been published, there is no advantage in going into the details of manufacture at this time.

Cellulose Acetate was first made in about 1869 by Schutzenberger and Naudin but although a great deal of research was devoted to its uses for other application, the research and commercial development of Celanese has been almost entirely during the last decade and the great success achieved by Celanese yarns and fabrics is very largely due to the inventions and work of Doctors Camille and Henri Dreyfus.

All being more or less familiar with the manufacturing processes for the different types of synthetic fibers, you can readily appreciate the importance, in fact necessity of differentiating between Celanese and those fibers made by the Viscose, Nitrocellulose and Cuprammonium methods.

Celanese consists of a chemical compound of cellulose, viz: cellulose acetate distinguishing it from the other types of synthetic fibers, all of which while differing from each other in the method of arriving at the finished product, are similar as regards the chemical constitution of the respective products, all being regenerated cellulose. Viscose fibers are produced by precipitating regenerated cellulose from a solution of cellulose xanthate. Nitro cellulose fibers are produced by coagulating or precipitating a solution of nitro cellulose, thus forming a filament of nitro cellulose which because of its inflammability has to be denitrated. Cuprammonium fibers are produced by precipitating regenerated cellulose from a solution of cellulose in Schweitzer's reagent.

Perhaps one of the most interesting phases of Celanese, has been the development of dyestuffs and methods of successfully dyeing Celanese yarns and fabrics to give shades which meet the present stringent demands for fastness to light and washing. Early in the history of Celanese, it was found that the Acid colors, Basic colors, etc., were unsatisfactory, because of their fugitiveness to one or more of the usual color destroying agents, but it was only after extensive research work in the laboratories of the British Celanese Ltd. that the first range of suitable colors was developed. These dyestuffs are designated as the SRA Colors and they are now so widely known and their use so universal that only a very brief description of them is necessary. They have been developed for dyeing Celanese only. They leave cotton and regenerated cellulose fiber white and only slightly stain silk and wool. All shades are dyed direct except black, which is diazotized and developed. In conjunction with direct and acid dyes which leave Celanese white, or are Celanese resist, the SRA dyes open up endless possibilities for dyeing bright and contrasting two-color effects in one bath on fabrics made of Celanese combined with cotton, rayon, silk or wool. The Celanese Corp. of America has published leaflets presenting general methods and practical formulas for dyeing Celanese with the SRA colors and also giving fastness tables of the individual colors. These are available on request.

It is a far cry from the week more than four years ago when one zealous trade organization printed and distributed many thousands of circulars which read essentially as follows: "Please be informed that there is a new silk now on the market which is called Celanese Silk. This silk cannot be dyed. If chloroform is used to take out a stain, the silk becomes hard and brittle and falls apart. . . . It is only made up of a composition of sawdust and ground celluloid." We have known of its being referred to by the uninformed as being made from gun cotton and, consequently, explosive; as being made from celluloid and glue and that if a dress made from it were washed, the glue would dissolve and the dress fall apart. Not long ago a dyer informed me that he had tried four times to dye it with a certain direct black and each time it came out a beautiful golden brown. He wondered if it could possibly be Celanese and if so, what should be used to dye it with. You may well smile at those ridiculous statements and I am sure that those by whom they were made were not members of this organization, or if

they were, they did not believe in attending many of your Sectional or National Meetings.

In the dyehouse, there are just two specific precautions which should always be observed: 1) If the natural luster of the fiber is to be preserved, temperatures in wet processing should *not* exceed 180° F. 2) The use of strong alkalis should be avoided.

It should be borne in mind that Celanese has a lower natural moisture content than any other type of fiber either natural or synthetic. It is also the most resistant of all textiles in moisture absorption properties and, consequently, wets out more slowly and as it has low moisture retention power, it dries very quickly. The natural effect of this particular characteristic is that the yarn or fabric must be slowly dyed.

Dyehouses today are receiving Celanese yarns in a great many different types of fabrics, fabrics made entirely of Celanese and fabrics of Celanese combined with silk, wool, cotton and rayon. Sometimes the Celanese is combined with more than one of the other fibers.

Before dyeing, the fabric should be wet out and scoured to remove the small amount of lubricating oil which is generally present. The usual scouring agents are a good alkali free soap and ammonia. Occasionally, goods are received from the grey goods mill containing large stains resulting from attempts made by the grey goods mill to remove oil spots. We have advised dyers that where such cases are numerous, they should take the matter up with the grey goods mill in question, instructing them to take every precaution to keep oil stains out of the goods, but when they do get in, to leave them there rather than stain a larger area by using some unsuitable cleaning agent.

Celanese fabrics are made in a great many different constructions and it would be hopeless to attempt to discuss each individual one, we will, therefore, briefly discuss groups according to the type of machine used for dyeing. The dyeing machines necessary for dyeing Celanese are in general those used in general dyeing practice. Monel metal lined machines are, of course, ideal and wood is satisfactory for all shades but more difficult to clean. Copper lining is satisfactory for all purposes except bleaching and black.

As is the case with other fabrics, the type of machine to use to obtain the best results depends on the construction of the fabric and the finish desired.

Jig Dyed Fabrics

Undoubtedly, more fabrics are dyed on the jig than in any other type of machine. In this group, we will place such fabrics as Satins, Twills, Taffetas and Failles. Each of these is, of course, made up in different weights but all are essentially the same in that they should be dyed in open width so as to keep free from creases. Standard makes of light running jig with roller bearings on the auxiliary rolls are most satisfactory as tension and stretching of the fabric may be reduced to a minimum. The fabric is batched and given the usual scour in the jig, and slowly dyed. After dyeing it is given a warm and a cold rinse to remove all traces of soap and then extracted on the horizontal batch extractor and finished. As a general rule, no finishing is required for all Celanese fabrics other than running over the tentering frame and possibly over the breaker. There are, of course, exceptions to this and I have with me one or two examples which I will pass around for your examination. The first example is two different weights of satin. The lighter piece was merely run over the tentering frame while the heavier piece, after being run over the tentering frame was run on the button breaker and then on the rifflage. Here also are two cuttings of taffeta. One was finished only on the tentering frame and the other after tentering was run through a warm calender.

In the occasional cases where it is advisable to use some finishing agent this should be applied in the last rinse after dyeing rather than in the finishing department.

Reel or Winch Dye Fabrics

All flat knit or warp knit fabrics are dyed on reels. The pieces are made up into rope form preferably in pieces of 40-60 yards. Overloading the machine should be avoided. The goods should be thoroughly scoured and after dyeing given a warm rinse and then an olive oil emulsion finish in the cold rinse. They should be only lightly extracted and then finished on either the stationary frame or the moving tenter depending on the construction. Crepes, either all Celanese or Celanese combined with other fiber are also generally dyed on the reel. However, in dyeing crepes, it is essential that they be thoroughly wet out before being put on the reel so as to avoid creasing. This should be done in open tanks treating for two to four hours depending on the fabric. After thoroughly wetting out, the fabric is placed on the reel machine and dyed in the usual manner. Here I might say that if the fabric is a combination of Celanese and silk the dyer must decide on the type of dyestuff to be used for dyeing the silk component. He may select suitable direct colors in which case the dyeing of both fibers may be done in the one dyebath or if he decides to use acid colors, two dyebaths and two dyeing operations will be necessary. In the latter event it will be preferable to dye the Celanese component first as the SRA colors will stand cross-dyeing in an acid bath better than the acid colors will stand cross-dyeing in a soap bath. Crepes, after dyeing are given the usual warm and cold rinses and then extracted on the vacuum or suction extractor and finished in the loop or crepe net drier. A great many Celanese or Celanese and Silk crepe constructions have been made but I have brought with me for your examination a sample of our All-Celanese Crepe

Amcella and one of Celanese and Silk, our Crepe Malika.

Open Tanks

Open tanks are most used for boiling-off, scouring or wetting out, however, certain fabrics may be dyed to advantage in these tanks. Voiles and Ninons for example are, undoubtedly, being dyed in some plants on jigs, in others on reels depending on the skill or belief of the operator. They may well be dyed in open tanks and quite economically. These fabrics, because of the comparatively high twist of the yarn require thorough wetting out before dyeing. The fabric is plaited and suspended by strings attached to one selvedge in the usual scouring and dyeing bath. This applies, of course, to batches of from two to four thousand yards to a shade. For small batches it is more economical to scour in the open tanks and then dye on the reel. After dyeing, the fabric is extracted, tentered and possibly run over the breaker.

Celanese velvets are dyed in the usual velvet or Star dyeing machine and extracted on the vacuum extractor.

Yarn may be dyed either by hand with the two stick method or in the standard yarn dyeing machines. To facilitate winding, it is recommended that after dyeing, the yarn be given an olive oil emulsion finish.

Hosiery made entirely from Celanese or Celanese combined with other fibers is being dyed by a great majority of the hosiery dyers without difficulty.

By a careful selection of dyestuffs, cotton in the presence of Celanese may be dyed with either Sulphur or Vat dyestuffs. Information on the use of these types of dyestuffs will gladly be supplied on receipt of written requests.

One phase in the processing of Celanese of interest to the colorist which I have not touched upon and which we have no time to go into at length is the printing. I will say, however, that considerable progress has been made in Discharge Printing in the past year and today a few printers are doing commercial discharge printing on black and navy backgrounds without changing the chemical construction of the yarn, a few samples of which I am passing you for your inspection.

Mr. Price: If there are any questions you would like to ask I will be glad to answer them if I possibly can. Otherwise, I thank you for your attention. (Applause)

Mr. Ira L. Griffin: What pH can be used in degumming Celanese?

Mr. Price: I would say that in degumming silk in the presence of Celanese you can go to a pH as high as 10.5 with safety.

Mr. Stott: What temperature is that, Mr. Price?

Mr. Price: That is 75 to 80 degrees centigrade. Then, you can maintain that for three or four hours.

Mr. Stott: I don't think you will get a sufficient degumming of the silk at that temperature with a pH of 10.5.

Mr. Price: You will unless you have a very high crepe back.

President Killheffer: Are there any further questions? This is your opportunity.

Dr. Jos. F. X. Harold: If it is not too much of a secret I am sure some of the telepathy that has gone on between yourself and Mr. Wood might be broadcast to the rest of us. If you can give us a good method of discharge printing without delustering Celanese in any way, I am sure we would be glad to hear about it. Have you any directions for doing that? The others would like to know that, too, I am sure.

Mr. Price: I am sorry, Dr. Harold, I can't give you that information because I don't know it myself. I don't know anything about the printing end of it but the information is available if you care to write in to the New York office.

President Killheffer: Are there any further questions?

Mr. Stott: Mr. Price, can you tell me what the action of ammonium sulfocyanate is on its luster

Mr. Price: You will get a relustering. Some of the work that was done two or three years ago with sulpho cyanide was done in creating what we called at that time "similis" prints, where the fabric was delustered and then the design printed on, using calcium or ammonium sulpho cyanide, and that relustered the fabric.

Mr. Stott: The reason I asked that question is because I happened to see in some magazine a method of discharging Celanese, using ammonium sulphur cyanide as a base in conjunction with some animal charcoal, I believe. I wondered if there had been any practical experience with that particular process.

Mr. Price: I can only again express my ignorance on the printing end of it.

Mr. Harry R. Davies: Might I ask the method of delustering Celanese, where you can control the degree of delustering?

Mr. Price: A temperature of from 92 to 98 degrees centigrade and with most types of fabric, it should be kept an open width—

Mr. Davies: What delustering agent is used?

Mr. Price: Nothing other than temperature.

Dr. Jos. F. X. Harold: Have there been any improvements in making Celanese faster to hot ironing?

Mr. Price: There has been a method developed which we have called the iron proofing method which consists of a partial surface saponification of the fiber. But it is not generally used to any great extent today except in the men's lining trade.

Mr. P. J. Wood: Isn't it a fact that the delustered Celanese can be relustered by pressing at a very high temperature?

Mr. Price: If it is ironed at a high temperature when the fabric is wet it probably will reluster.

Mr. Wood: Even without wetting?

Mr. Price: No.

Mr. Walter H. Zillessen: Is there any stripping agent to be found that doesn't necessarily delusterize?

Mr. Price: There is nothing better than hydrosulphite.

Mr. Zillessen: Is that uniform in most of the colors?

Mr. Price: I can't answer that for all colors because colors have different properties and vary considerably but it is safe to use the hydrosulphite on Celanese.

President Killheffer: Are there any further questions? If not, we thank you very much. (Applause)

The local section has arranged some further entertainment for us this evening, and while we are waiting for them, I want to ask you to please be on time for our session tomorrow morning at ten o'clock.

I also want to at this time appoint two tellers, who can secure the ballots from Mr. Low and count them so that they can report the election at the business meeting at two o'clock tomorrow afternoon. I will appoint as tellers Mr. Hoppe and Mr. Thompson.

. . . Entertainment. . . .

SATURDAY MORNING SESSION

The meeting convened at ten-ten o'clock, President Killheffer presiding.

President Killheffer: Our first paper this morning is by Professor Willis, of Clemson College, "The Needs of Tests and Research in Textiles." Professor Willis!

. . . Prof. H. H. Willis presented his prepared paper. . . (Applause)

Need for Tests and Research in Cotton Textiles

By H. H. Willis,

Director Textile Department, Clemson College, South Carolina

MR. CHAIRMAN, Gentlemen of the American Association of Textile Chemists and Colorists, I appreciate the opportunity of discussing with you "The Need for Tests and Research in Cotton Textiles." I wish to state in the beginning that I am not a chemist. My experience has been in cotton manufacturing and cotton spinning research. However, as you know, anyone who has had very much practical experience in either of these lines has met with many problems involving either physics or chemistry or both.

Keen competition within any given field of industry inevitably brings about investigations, tests, and research within that industry. Each competitor is seeking to reduce cost without sacrifice of quality. The cotton textile industry is no exception to this rule. On all sides it is being confronted with problems, some of which are chemical. The solution of these problems often spells the difference between profit and loss, between success and failure. I believe that the textile industry is now recognizing the fact that the textile chemist can aid materially in the solution of many of its problems. These problems involve profit; research conducted by a chemist on the mill pay roll must pay dividends within a reasonable time. The manufacturer is interested primarily in the best, cheapest and most desirable supplies and methods. He wants to find out what oils, starches, detergents, dyes, etc., give best results at least cost; he wants to know what methods of procedure are most efficient. It is my opinion that the large textile concern has enough chemical problems to warrant having its own textile chemist. I believe a competent chemist saves far more than he costs.

The leaders of the industry are coming to recognize the fact that men must have specialized training and qualifications to conduct tests and research. This is evidenced by the fact that Clemson Textile School, even in the face of business depression, had twice as many calls for its textile graduates of last June as it had men to fill the particular positions. In many of these cases the company wanted a man to serve as assistant to the superintendent and to conduct tests. I have in mind one of our recent graduates who has been very successful in tests and laboratory investigations with one of the large rayon concerns. Out of the last two textile classes we have several graduates who have charge of the tests and research in cotton manufacturing plants in South Carolina. This is gratifying to Clemson, and for this reason we are making special effort in reorganizing the various textile courses to meet the present day needs of the industry. Necessarily we are teaching theory, but we are stressing theory in its practical application to manufacturing processes and problems.

Although this need for textile research and tests is recognized, frequently the mistake is made of having men conduct tests or research in a field in which they are not particularly trained. For instance, when a man experiments with starches, it is my opinion that he should have some knowledge not only of the chemistry and test methods involved but also some experience in the practical use of starch in a mill. I know of a case in which a superintendent with no special training in chemistry or research methods attempted to do his own experimental work on starches and lost enough money in one week to more than pay the salary of a good textile chemist for a year.

Does the Cotton Fiber Offer Any Problems for the Textile Chemist?

Though we use thousands of bales of cotton in our mills each year, we know very little of the chemical and physical properties of the cotton fiber. For instance, what do we know of the effect of heat, light or moisture upon the working, the weaving or the finishing qualities of cotton? What causes the insulation of electrical wires to last considerably longer in certain sections of the country than in other sections? I am informed that the insulating material on electric wiring in the Southwest lasts, in many instances, only one tenth as long as similar material in other sections of the United States. The writer has seen cotton stored in the open in Arizona very badly damaged from the intense light and extreme heat. The cotton appeared to be nothing more than degraded cellulose. What chemical changes of the cotton fiber have taken place in these cases? If there can be determined and prevented, it will result in a considerable saving.

I have seen two lots of cotton produced under similar conditions and seemingly similar in character which when placed in the drawing frame and drafted under the same mechanical and moisture conditions, did not produce the same weight sliver. Just what causes this difference? What caused one to react differently from the other under the same moisture and mechanical conditions?

These are the kind of practical problems which are of great concern to the textile industry. The layman may not be interested in the chemical constitution of cellulose as chemistry but he *is* intensely interested in the practical application of chemical knowledge.

Grades of Cotton

The grade of cotton, as you know, is dependent mainly upon three factors: color, trash, and preparation. The color classification includes the whites, blues, grays, and yellow tinges and stains. We have little information on just what causes these different colors of cotton and just what chemical and physical changes take place. However, we do know that these different grades require different treatment in bleaching, dyeing and finishing, in order to obtain the most uniform results. What is the best way to bleach, dye and finish yarns and fabrics made from the respective grades of cotton? Probably no two answers to this question would agree in all respects.

I have a case in mind. Yarn was spun under the same mechanical and moisture conditions from a given lot of cotton. Portions of this yarn were then finished by different plants, which of course used different methods. The finished product from each plant was tested for strength and color. Results varied widely. Why? The answer involves considerable chemistry research. Another case: Yarn spun from low grade cotton which contained some blue cotton was divided into two lots, one of which was bleached in Plant A while the second lot was sent to Plant B. A portion of the yarn at Plant B was given a single bleach and a portion a double bleach. When these yarns were tested, those from Plant A were brighter and whiter and took dyestuff better than either the single or double bleached yarns finished at Plant B. The strength of the yarn given the double bleach at Plant B was 20 per cent less than that given the single bleach at Plant B or that given the single bleach at Plant A. Thus, as you see, there is considerable room for research for the textile chemist in this phase of the textile industry.

Since it is my business to direct the training of textile men at Clemson Textile School, let me emphasize the point previously made, namely, that the mill chemist needs not only a knowledge of chemistry and test methods, but he should be familiar with manufacturing processes as well. The mill chemist doubtless has many so-called chemical problems submitted to him which may be solved by mechanical knowledge rather than chemical. A few cases will illustrate.

In cotton manufacturing different grades of cotton are frequently mixed in the opening room. If this mixing is not done uniformly, the goods when finished may be streaked, in which case the dyer and finisher are inclined to shift the responsibility to the manufacturer and vice-versa. I knew a case of this kind in which the dyer took the responsibility until he, by chance, saw the results of some tests and experiments on bleaching and dyeing different grades of cotton. Up until that time he had not known that blue or gray cotton did not bleach or dye as well as the yellow tinges and stains. He immediately took the matter up with the cotton manufacturer. Investigation showed that the streaks were due to the fact that the small amount of blue cotton used in the plant was not being uniformly mixed with the whiter grades.

Another case—Some months ago I was called upon to settle a controversy in connection with a fabric which contained thick and thin places. The manufacturer who wove the cloth thought that it was possibly a defect in the finishing, but that it might be caused in some of the spinning processes. Accordingly, the case was first taken up with the yarn manufacturer who attributed the trouble to the character of the cotton; the cotton buyer in his turn placed the responsibility upon the boll weevil poisoning used on the cotton plants. Upon analyzing the fabric, it was evident that it was a case of mixed yarn. Fillings

from two different plants were being used in this particular fabric, one being much better in quality than the other. The filling in one case was very uniform, whereas in the other it was very irregular, being "thick and thin" as termed by the mill man. These bobbins of filling were put together and used as they came to hand. Thus the better filling yarn often alternated with that of inferior quality. The difference was, of course, very evident when seen side by side in the finished product. Recently a hosiery manufacturer came to our textile school for information in reference to a fabric taking the dye unevenly. When Dr. Mullin of our Chemistry and Dyeing Division made an examination of the yarn, he found that it was made of two different kinds of rayon, which did not take dyestuff to the same degree. Two types of rayon were in use in the plant and somehow had become mixed.

In each of the several cases just cited, it was necessary that the chemist understand manufacturing processes in order to analyze his problem intelligently and to solve it. Knowledge of chemistry alone would not have been enough.

These and many other similar cases which have come to our attention at Clemson College Textile School have caused us to add textile testing to our regular schedule of courses and to install the latest equipment for testing fibers, yarns and fabrics. Our testing room is equipped with both humidifying and dehumidifying systems which enable us to produce and control any desired relative humidity between 65 and 100 per cent at any given temperature between 50 and 100 degrees.

The cotton textile industry needs the services of textile chemists who have familiarized themselves with manufacturing processes and methods, and the demand for men thus trained will increase as the industry expands.

President Killheffer: I am sure that we have enjoyed very much Professor Willis' presentation. I don't know whether it has suggested to you any comments or any questions. If it has, now is the opportunity for you to comment or ask questions.

Dr. Powers: I should like to raise a point at this time. From my experience in hiring men who shall do research as they come from the schools, the textile schools and universities, I rather differ with the speaker in his statement that what our students need is experience in manufacturing methods. In my opinion there is no question that what our textile school men need is knowledge of chemistry. In other words, the knowledge of manufacturing methods you can give to a man in your plant in a very short time but you cannot give him the knowledge of chemistry, physics and mathematics which he gets in the university.

I think it is deplorable that at the present time the men from our textile schools have not enough of the fundamentals and very much too much of the practical. In other words, the practical things that they stress, such as testing and the control of plant processes, change very rapidly in all the modern plants. Those things the man can get when he goes to his particular plant. The things he cannot get are the fundamentals. I regret to say that I haven't met a textile school graduate who can use calculus, who knows organic chemistry thoroughly, who knows the application of physics and I want to put myself on record as saying that the men we want for research in the textile industry must have those fundamentals. The reason the textile industry is partly backward is because we have not men who do know their chemistry, their physics, their mathematics. Those are the things they must have.

We don't want to hire a man tomorrow who knows how to control the different yarns, who knows what Rayon, Celanese and Viscose look like, because they change within a year or two. What we do want is a man who has a certain amount of common sense, a certain amount of ability to observe, but back of that a fundamental training in mathematics, physics and chemistry.

President Killheffer: Dr. Powers, I think your comment is very interesting, and unless I miss my guess, Professor Willis likes to hear just that sort of comment and suggestion. I am sorry that Professor Olney isn't here because I have heard questions asked a number of times that would lead to just the sort of answer you have given. That is, the educators connected with the textile schools I believe are most anxious to determine how they can improve their present courses.

Prof. Willis: Mr. Chairman, I quite agree with the gentleman. We are attempting to make an application of this particular theory to practice because we believe that is the only way that men can understand the theory. If you remove it too far from practice, you don't obtain the same results.

I believe that a number of the men in that particular work would agree.

I also agree with Dr. Powers that a man should know chemistry, but it takes considerable practical experience as well. I was just trying to touch on our method of training in a general way, and I can point out to him a number of cases, as I stated awhile ago, where within less than two years these men are functioning efficiently in the plants, and they are some of the most progressive plants in the South.

Dr. C. E. Mullin: I thoroughly agree with what has

just been said in regard to the training of the student. If he doesn't get it in college, he never gets it.

You spoke about calculus. We give it to them.

I will tell you this; you can't turn out a doctor, an M. D., who is a specialist in four years' time. A man first studies medicine. If he wants to become a specialist he then takes a course in his specialized line.

That is one trouble with the textile chemistry courses today. I believe there are some schools tending to give textile chemistry in three years. I say frankly that I cannot hope to make a thorough textile chemist in four years. If the boy will take four years of regular chemistry and then give me a year, he will have lot better possibilities. The fact is that while I do not believe that our course is secondary to any in the United States—that may sound very egotistical but I am frank in saying that is what I believe—our boys get no textile chemistry and dyeing until their senior year. We cannot make specialists until we have first made the chemists.

The fundamental thing back of all textile chemistry is the same fundamental principle back of sugar chemistry, fuel chemistry, or any other branch of chemistry.

My idea is to first make the chemist and then try to make a specialist out of him.

There is one thing about it: that you must in every way possible try to connect the theory with the practice. If you study the theory as an abstract subject without taking in practice, the boy doesn't get it. Men who have never tried it will be amazed to find how little the student correlates study with practice.

I will tell you an actual incident that occurred in the first year of my teaching.

I took a boy through the Pacific Mills Bleachery. The boy had studied bleaching in the laboratory, before we had very large-sized apparatus. This was four years ago. The boy had studied bleaching in the beaker. I took him through the Pacific Mills and explained the bleaching to him. When we got out the boy said, "What are they doing there?"

I said, "You don't know what they are doing? We just told you."

He said, "You can't kid me. They don't bleach that way. They do it in the laboratory."

That is an actual fact. (Laughter)

That shows how important it is to give the boy something of the practice along with the theory. At the present time we are carrying that practice to this point: we are trying to install wherever possible the smallest size of actual plant equipment. We have actually installed the smallest piece of piece dyeing equipment so that the boy can correlate his theory with his practice. Otherwise, he does not obtain it.

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AMERICAN DYESTUFF REPORTER

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OUR NEW DRESS

WITH this issue the AMERICAN DYESTUFF REPORTER appears in reduced size and in a new cover, both of which innovations we hope will be approved by our readers.

The change in size is dictated solely by considerations of convenience in handling. We feel that the smaller page will permit the magazine to be folded and carried in the pocket with considerably less inconvenience. We also believe that decrease in weight, because of the somewhat smaller page, and the lessened "floppiness" will make it considerably handier to hold when reading.

There is no change in the type size of the page or of the advertisements. The economy is effected entirely at the expense of the white margin. This, of course, gives the page a somewhat more crowded appearance but we believe that the advantages off-set the disadvantages.

At any rate, we shall carry on the experiment throughout 1931, and at the end of that time will ask our readers to express their preference as to the size to be followed in 1932. It is impractical to change the size in the midst of a year because of the fact that many readers wish to have copies bound for their libraries.

WHAT OF 1931?

VERY few of us were sorry to see 1930 pass out of existence. It was one of those years of readjustment which are to be expected in every business cycle and should have occasioned no surprise to anyone. Nevertheless, depression and retrenchment are unpleasant to experience even though they may have been predicted with confidence and prepared for to the best of one's ability. The fact that many individuals and corporations failed to make adequate preparation, of course, enhances the discomfort experienced.

There are multiplying signs in plenty that industrial conditions as a whole have turned for the better. It would be a grave error, however, to assume that recovery in business will be rapid or steadily upward from the present depressed level. In fact, a too rapid recovery would probably be the surest way to retard permanent revival. The sporadic upswing in the stock market and the expressions of rampant optimism which were so prolific during the early months of 1930, are a case in point. It is quite probable that had the trend of liquidation been allowed to run steadily throughout the first quarter of last year, we would now be considerably further advanced in the recovery phase of the cycle. We do not believe that industry as a whole will make the same error at this time.

There should, however, be no occasion to fear increased depression during the coming year. Liquidation of every sort has run pretty well unchecked for at least nine months, and with the exception of the rally of last spring, for nearly a year and a half. Considering the violence of the decline during a portion of this period, the seven years of advance which culminated in the summer of 1929, should be by now fairly well compensated.

We believe that 1931 will see slowly but steadily improving business conditions and that individuals and corporations may safely lay their plans and arrange their budgets on the assumption that conditions will be at least no worse than they are at the present moment, and with every probability that there will be definite improvement before the end of the year. If all will take conservatively constructive action of this type there is no doubt whatever that the improvement in conditions will be most pronounced within another six months.

There never was a time in recent years so favorable to the purchase of goods of all kinds as is the present. Individuals or corporations who must shortly face expenditures for plants, equipment, dwellings or indeed almost anything which money will buy, and who have the cash to pay for them at the moment, or who can finance their purchases without straining their credit should lose no time in getting their programs under way. They are undoubtedly able to get more for their money today than has been the case in many years past, or is at all likely to be the case again in the near future. Even labor is pretty well liquidated, for although wage scales in most industries have not been reduced, and probably will not be reduced, it is, nevertheless, possible to pick and choose individual laborers, with the result that labor today, on competent authority, is delivering 20 to 25 per cent more work per dollar of wage than was the case two years ago.

At no time since the pre-war days has credit been so plentiful or loans on securities so cheap as the present. The recent reduction of the re-discount rate by the Federal Reserve Bank of New York to 2 per cent, and the simultaneous statement of this institution that there was available a stock of "free" gold in excess of one billion dollars, should serve to satisfy the most skeptical

that anything in the way of money stringency is impossible in the near future.

We cannot urge our readers too strongly to contract now for the construction of improvements or additions to their plants which are likely to be needed in the near future. There never has been a time when antiquated machinery could be replaced to better advantage. When mills are running to capacity it is impossible to replace obsolete machinery because of the rush of business. When plants are running at 50 or 60 per cent of capacity, however, it is a simple matter to throw the load on to one group of machines while another is being replaced. Far-sighted managers who take advantage of the present opportunity to put their plants in A No. 1 working order will undoubtedly reap rich rewards in the shape of increased earnings and greater operating efficiency as soon as business begins its upward trend.

All in all we believe that 1931 will be a not unsatisfactory year for all, and that those who appreciate to the full the opportunity which the present offers, and who are both able and courageous enough to grasp it, will find ample cause for self-congratulation twelve months hence. A. P. H.

EXTRACTORIALS

Fortunately, we have learned not to be too dogmatic on the subject of advertising. Consequently we admit our inability to state flatly that the success of the silk campaign, for example, might not divert from the rayon industry a few pennies of the dollar which had been heading in that direction. We do know, however, that these campaigns, if properly formulated and prosecuted, can bring a new dollar into the textile industry as a whole. The division of that new dollar will depend upon the relative aggressiveness of the various branches.—*Textile World.*

I'm going to answer that question a bit summarily by saying: In Europe and the Near East the alleged foreign enmity toward this country and its business efforts is largely mythical right now — a figment of superheated imaginations. To be sure, you can find some local irritation or envy in certain spots—but any general, organized animosity or malevolence toward American commerce or the American people is virtually non-existent.—*Dr. Klein, Asst. Secretary of Commerce in U. S. Daily.*

Revere and his horse, Lindbergh and his motor, were effective partnerships. Either partner would have been impotent without the co-operation of the other. Exactly so are the news and advertising columns of the newspaper of today. The advertising enables the publisher to get out a paper which will have a wide circulation and this wide circulation helps industry to maintain itself and still further expand.—*Stanley Resor, Pres. J. Walter Thompson Co., at Yale University.*

1931 Exposition of Chemical Industries

Plans for the 13th Exposition of Chemical Industries, which will be held at the Grand Central Palace, New York, during the week of May 4th, 1931, are in progress and rapidly taking shape. During the past summer preparatory work has been done in connection with the Students Course of Lectures and plans are now being laid for it.

The Students Course of Lectures will this year again be under the Chairmanship of Prof. W. T. Read, Dean of Chemistry at Rutgers University, and concerning the Course, he wishes to make the following appeal to the colleges and universities, and others interested:

"Plans are now being made for the Students Course of the next Exposition of Chemical Industries. Experience of the 1929 Course has indicated that a change of policy is necessary, in order to enable college students to attend such courses toward the close of the college year. The previous fall days found most colleges and universities either on the eve of opening or having been open such a short time that the few days lost from the campus were not a serious matter, but with the Exposition coming early in May, near the close of the academic year when reviews are under way and final examinations are in sight, it is difficult for any institution to give students of chemistry and chemical engineering a full week at the Exposition, and the previous system of two parallel courses of six days each, one for elementary and one for advanced students has been changed.

"And instead there will be three successive courses of two days each. One course will cover the elements of chemical engineering equipment, and the more important types of apparatus with which chemical engineering operations are carried out. Following this will be a two-day advanced course dealing with the more specialized equipment of recent development in various fields, reviews of research which have marked advances from the theory and principles of chemical engineering. The third course will deal with the new materials and processes of chemical industry, due emphasis being made on the chemical theories and principles rather than equipment, and also with significant topics of chemical economics.

"The regular course for students will be concluded at noon the last day of the Exposition. On Saturday afternoon an invitation is extended to High School, College, and University teachers to hear a series of lectures on the teaching value of the Exposition, which will be followed by a personally conducted tour to illustrate the material of the lectures.

"In the past a number of industries have made it possible for members of their operating, sales, and research staffs to attend some of these lectures, and we hope that this policy will be continued."

Already there are about three hundred exhibitors who have reserved space for the forthcoming Exposition, so that even at this early date prospects for an excellent Exposition are very good.

The Treatment of Water for Bleaching and Dyeing

By C. D. BLACKWELDER

Chemical Engineer, Greenville, S. C.*

THE quality of water used for washing, scouring, bleaching and dyeing is a matter of great importance. The use of an unsuitable water in such operations has in many cases resulted in faulty work. Of all the raw materials entering into the above processes water is by far the most important, since it enters every stage of the operation, either as a vehicle for the chemicals used or as a solvent for the impurities which have been removed. The difference between the results obtained at two different bleacheries is very often due largely to the difference in the composition of the water.

For many years the importance of the character of the water supply has been recognized. In fact this consideration has been one of the principal ones in controlling the geographic distribution of the textile industry, and we find as a result that our textile centers in this country are located in the Eastern and Southern states, where the water supplies are abundant and respond to purification treatment very readily. In recent years much progress has been made in the field of water purification for textile plants, with the result of improvement in water supplies and textile products. Due to these improved processes and equipment for water purification the textile industry now is not as dependent on geographic location, in order to get a suitable water supply for use in processing the goods, as it has been in the past years.

The majority of the bleacheries take their water supply from rivers or creeks, some obtain their supplies from springs and wells. Practically all these raw water supplies require some form of chemical treatment and sedimentation and usually filtration and in some cases softening.

This short paper will not cover the various types of water treatment plants and the particular type necessary for waters of various compositions.

Most textile men are familiar with the usual type of filter plants found in connection with the textile plants that were built prior to six years ago. Since this time many changes in the design of the plants and the application of chemical treatment have been made. The design of the mixing chambers, coagulating basins, filter beds and operating controls have gone through a period of improvement.

The average filter plant produces water that is practically free from turbidity and suspended matter and the water is fairly clear and sparkling. Due to the physical appearance of this water it is rarely suspected of causing trouble in the processing of the goods. Frequently goods are damaged to a greater or less extent due to certain minerals and colloids being left in the water, which are not visible to the unaided eye. Sometimes the raw water supply as polluted with sewage, bleachery and dye waste and other trade wastes and although the water is clarified, certain harmful elements have been left in the water. Certain spore forming bacteria also may be present in the water, which are hard to destroy and often give trouble in the bleachery by producing stains, peculiar odors and moulds.

A very small amount of suspended matter will cause trouble in a bleachery when the water is allowed to circulate on the cloth or yarn. It will cause a precipitate which results usually in a brownish stain. The process of bleaching and dyeing yarn, in package form, is very sensitive to any suspensions and insolvent products formed by the chemicals used, therefore, water of the best quality is required. Often the bleacher or dyer is blamed for faulty work which is entirely due to the water and is beyond his control.

Iron in its various forms is one of the greatest sources of trouble in water supplies. In a great many cases dyers blame their dyestuffs and chemicals for causing uneven dyeing when really the trouble is in the quality of the water. Bleachers often hold their breath when removing the lid from the kiers, just as a small boy does when opening a prize box, for they are anxious to know what kind of results they have gotten from the boil. Sometimes the boil is perfect but due to circulating the water in the kier after the boil, suspended and colloidal matter is precipitated on the cloth. Very often these water stains are confused with "kier stains," which are often due to the precipitated pectin matter from the spent kier liquor.

In a great many cases that have come under the author's observation the kier and the goods therein have actually been forced to act as a "filter plant." With a properly treated water supply many stains can be eliminated and a reduction in the quantity of chemicals used in processing the goods will be made.

Water with excess hardness should not be used for

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*In charge of Chemical Engineering Operations. J. E. Sirrine & Co., Consulting Engineers.

For presentation at the Southern Textile Meeting of The American Society of Mechanical Engineers.

bleaching and dyeing. Hard water is not as good a solvent as soft water. It causes secondary reactions with the chemicals used in the various solutions with the result that more chemicals are required in the processing of a given quantity of goods.

Unsatisfactory results from the use of hard water are seen more often in the kier boiling than anywhere else in the bleach house. The calcium and magnesium salts, which are known as hardness, form insoluble compounds with the alkalis and soap compounds used in boiling. These insoluble particles, if left on the fiber, become worked into the cloth and form a protective coating in spots which will not allow the goods to bleach properly. If the goods are dyed, these spots resist the penetration of the dye and cause light spots in the dyed goods.

Many textile plants have well designed and efficiently operated filter plants. Each year, more plant executives are realizing that the quality of water they are using is not the best. In order to get a better product at a reduction in expense, they are modernizing their old water treatment plant or building an entirely new one.

There are many water treatment plants in use today that are being called on to produce satisfactory water for processing but great difficulty is being experienced in getting the quality of water required. Very few of these plants that are not functioning properly, were designed especially to treat the raw water being handled. The proper chemical and physical studies of the raw water should have been made and the results interpreted correctly and applied in the designing of the plant. There is no comparison in the exterior beauty of some of these buildings and the quality of water being produced.

Some of the plants that have come under the author's observation for study and report were producing water of such poor quality that a considerable amount of the goods handled, in the bleachery, had to be processed the second time. The production of delicate shades was impossible. Many of these hit-and-miss type water treatment plants were designed without sufficient mixing chambers in which the raw water and coagulant should receive proper agitation before passing through the stilling wall into the coagulating or subsidence basin. In nearly every case the retention period in the coagulating basin was too short and the velocity through the basin too great. In a number of cases the rate of filtration through the filter beds was entirely too high. The sand in the filter beds, in a number of cases, was not of suitable quality and size for the particular water being filtered. The filter underdrainage system was clogged up or corroded so badly that it was impossible to get proper distribution of wash water. On checking up the cost of operating these plants the chemical dosage was excessive, which made the chemical treatment very expensive. Due to improperly designed coagulating basins and filter beds the filter runs were short, which resulted in the use of a high percentage of the filtered water for backwashing, thereby reducing the net output of the filter plant.

Many of these plants are not provided with proper equipment for controlling the alkalinity and Hydrogen ion concentration or pH value of the filtered water. This is a very important subject and should receive proper thought by all owners of filter plants. Perhaps all of you have observed "red water" running from hot water spigots when they are first turned on. This red water generally contains iron, due to corrosion in the pipe lines and heaters, and is caused by the dissolved oxygen and carbon dioxide in the water. By controlling the Hydrogen ion concentration or pH value of the water, this corrosion can be greatly retarded. Water lines supplying bleach and dye plants are very often badly corroded due to this same cause.

Particles of rust entering the bleach and dye liquors cause considerable trouble. The cause of this trouble can be practically eliminated by proper treatment of the filtered water before leaving the water treatment plant.

Many of the so-called troubles in the bleachery and dye house can be avoided by proper treatment of the water supply. Proper study should be made of the particular water to be treated before designing a water treatment plant. Full knowledge of the processes and the chemical reactions involved in the bleachery and dye house should be known before deciding on the chemical treatment of the water. Many tests should be made on the raw water over a period of several months if possible. The tests should include complete mineral analyses, as well as bacteriological studies. Studies and observations should be made of the chemical dosage required, size of the "floc" formed by the coagulant, rate of floc formation and precipitation, nature of the colloids, turbidity and color removal, clarity of the water between the floc and turbidity and color in the settled water. In addition to this, studies should be made on the corrosive properties of the water with a view of eliminating this evil.

After the water treatment plant is built and the operators instructed in the operation, the plant must not be forgotten. The composition of the water in nearly all rivers and streams is changing constantly, due particularly to sewage and trade waste pollution. This being the case the filter plant operators require technical service and instructions periodically.

Great improvement in the operation of old water treatment plants have been made by many textile firms by securing the services of a specialist in this work. This paper has discussed only a few of the problems in water treatment for bleacheries and dye plants. There are a great many here who are not interested particularly in this phase of water treat-

ment and use, but are interested in the subject of water for use in boilers for the production of steam, in humidification, in size mixing, and for domestic use. Water for each of these uses is receiving more attention each year and some wonderful improvements and savings to the owners have been made.

Determination of the Action of Light Upon Dyeings

By Dr. Paul Krais

Translated from Kolloid-Zeitschrift LII, Heft 2 (1930), *by Fred'k S. Beattie*

IT IS frequently a long time before a new scientific method of working makes its way into general use. Oftentimes it meets with general recognition only after it has been improved, made suitable for general use, simplified, or developed further, whether by the originator or by someone else. In the case which I am about to describe, however, the method has remained unaltered; only its superiority and its limits have become better known than appeared at first possible in the minds of others than the originator.

It is a happy thing for me to recall the pleasant, carefree period which I spent in Tuebingen, after fifteen years of activity in industrial laboratory work. One of the fruits of that period was the attempt to measure the action of light upon dyeings with a "fading-hour" scale, as I proposed in the Zeitsch. f. angew. Chemie 1911, p. 1302. At the time, there was no reason to hope that the effects and the duration of insolation at different times of the year and in different places could all be brought "under one hat," as we say; under a generally comprehensible and easily employed formulation. The measurement of hours of sunshine, which offers no difficulty with the customary meteorological instruments, was not sufficient; the photochemical method, which had been proposed by various investigators even since the time of Bunsen, was as little useful; and the photographic method for measuring light-action was, at least then, illusory, for the sensitive paper bleached out decidedly in the fixing process, whereby the picture, at first perfectly plain, was wiped out again.

But it seemed to me that a rather similar task was set for me, and so I began to try out coatings of dye-lakes, which were prepared from notoriously fugitive coal-tar dyestuffs. I found that the precipitations of Victoria Blue B (not R, as it stands incorrectly in my publication regarding it) upon kaolin were the most promising, for the fading of this combination is so evident that, within the first hour of exposure to direct sunlight, a distinct difference can be noted between each quarter hour, and within the next three hours it can be noted between each half hour. Apparently the eye is very sensitive to differences in this part of the color-circle; and, besides, the fading does not go in the direction of a gray, or of some muddy tone, but toward a pure white.

The procedure, in brief, is as follows: 200 g. of white kaolin are stirred up with 200 cc. of water, and to the paste are added 400 cc. of a solution of 1 g. of Victoria Blue B per liter; the whole well stirred, filtered, dried in air in the dark, ground up, and sieved. The coloring matter, made ready for painting on by mixture with some suitable binder, such as white glue, gum arabic, etc., is coated upon good white paper (free from wood-pulp) and dried; when dry, the "blue-paper" is ready for use (it must be dried and kept also in the dark). Now we construct our scale: 12 slips of the paper are fastened upon a board, and this placed in direct sunlight, the sun-rays falling perpendicularly upon it, on a perfectly clear day, between 11 o'clock and 2 o'clock. During this time, successive slips of the paper are removed at the end of each quarter hour, till the first hour is gone, then, every half hour. In this way we obtain the standards of "fading-hours," from 0 to 5. In exposure of dyeings, thereafter, we expose a slip of fresh paper with the samples, the paper being changed from day to day (in good weather daily); and in this way we can sum up exposure-periods of 10, 50, etc., fading-hours. The method is independent of the weather, of the time of year, and of the angle of incidence of the sunlight; it is dependent upon the place where the standards were established. Thus, for example, a set of standards which a friend prepared for me in Arosa shows a considerably more rapid transition from step to step, than does the one established by me in Dresden; that is, one sun-hour in Arosa corresponds to about 80 sun-minutes in Dresden. However, since I carry on my experiments in Dresden, I naturally use the Dresden standards; and, similarly, anyone can easily establish his own standards for the place where he is working.

How uncertain any other method of estimation is, may be shown by a single example. In Tuebingen I have measured, in the period between May 10th and May 18th, 31 fading-hours in 24.5 hours of sunshine, i.e., in 9 days. Then, in the period from May 19th to May 27th, in spite of there being 54 hours of sunshine, I could measure only 35.5 fading-hours. So, neither measurement by days of exposure, nor by hours of sunshine, give any accurate results.

For years I was the only one who used this scale of standards. More recently it has found adherents. G. Ziersch in his work upon the alteration of dyeings on cotton by light[1], R. Haller and G. Ziersch in "Photochemical Decomposition of Simple Azo Dyestuffs"[2], St. Jost[3], St. Jost and C. Fluetsch in "New Methods for Quantitative Determination of Fastness to Light"[4], and K. Eckardt, in "Studies in Basic Dyeing of Cotton"[5]—all these workers have measured the extent of irradiation in fading-hours by the "blue-paper" method.

[1] G. Ziersch, Diss. (Dresden 1929).
[2] R. Haller und G. Ziersch, Mell. Textil-Ber. 1929, 951.
[3] St. Jost, l. c. 1930, 255.
[4] St. Jost und G. Fluetsch, l. c. 1930, 286.
[5] K. Eckardt, Diss. (Dresden 1929).

General Water Treatment Corporation

Announcement was made by W. Spencer Robertson, President of the General Water Treatment Corporation, that the organization of that company had been effected by the exchange of over ninety per cent of the outstanding capital stock of The Permutit Company for stock of General Water Treatment Corporation and the acquisition of all of the capital stock of Ward-Love Pump Corporation. The time within which the remaining outstanding stock of The Permutit Company may be exchanged for stock of General Water Treatment Corporation on the basis of twelve shares of General Water Treatment Corporation stock for each share of Permutit Company stock has been extended to December 31, 1930.

Spring Hosiery Colors

Eleven new colors will be portrayed on the 1931 Spring Season Hosiery Card to be issued shortly by the Textile Color Card Association, it was announced today by Margaret Hayden Rorke, Managing Director. Advance swatches of these shades were recently sent out to members in the hosiery industry.

In creating these new colors, the Association has not only considered their fashion significance, but has correlated them with the colors promoted by the garment and retail trades. They are therefore carefully keyed in harmony with the basic ensemble shades chosen by the Color Coordination Committee of the National Retail Dry Goods Association.

The hosiery colors likewise coordinate with the official shoe and leather shades chosen by the Association in co-operation with the Allied Shoe and Leather Industries.

The Polytechnic Institute of Brooklyn has issued an invitation to the public to attend its open house on Friday, January 16th, between 4:30 and 10:00 o'clock. The chemical, civil, electrical and mechanical engineering laboratories and shops will be in full operation.

The General Dyestuff Corporation, offer as a new brand of the Helindon series, Helindon Khaki C R Vat Powder, which produces a bright rich Khaki shade of very good fastness properties of which the excellent fastness to light and fulling is said to deserve special mention. The new brand, which represents the color in the reduced form as a Vat, ready to use by just dissolving in boiling water, is recommended for the dyeing of loose wool and slubbing for woolen goods which have to stand the most severe tests in manufacturing and wear.

POSITION WANTED

As Boss Dyer on Full Fashion Hosiery capable of large production, excellent matchings. First class reference, location in and around New York. Address Classified Box No. 620, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

CHEMIST-EXECUTIVE AVAILABLE

Textile Chemist with twenty-two years' practical experience. Graduate Lowell Textile Institute. Four years instructor in Chemistry and Dyeing. Three years theoretical and practical experience in Peroxide Bleaching. Fifteen years in charge of chemical work in large textile plant. Experienced in purchase of dyes and chemicals. Excellent analyst, and one who can interpret results.

Would consider position as technical advisor to chemical or dyestuff executive. Address: Classified Box No. 638, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

Dyestuff Salesman with many years of Sales and Laboratory experience is desirous of a suitable position with manufacturing concern. Advertiser has an extensive personal connection in various States and can give first-class references. Address: Classified Box No. 657, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

Rayon and cotton dyer, skeins, technical training, 10 years' exceptional experience. Put your dyehouse on paying basis. All types of dyes, perfect matches, fine winding. Best references. Address: Box No. 650, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

PRINTER

Chemist-Colorist, 35 years of age, married, last 6 years Supervisor of Printing Establishment of one of the largest Eastern Plush Mills. Experienced in the printing of all colors on Mohair, Silk, Rayon and Cotton Plushes, also Brocaded Velvets and Soda Prints. Some Laboratory, Dyeing and Finishing experience. Will locate anywhere. Address: Classified Box No. 654, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.